on these limited data, sales of roughly 2 to 4 million dining chairs with upholstered seats and backs might be affected by the standard's seating area testing requirements.

3.2. Marketers of Upholstered Furniture

Annual domestic retail sales of all types of living room and family room upholstered furniture is about 30 million units with a value of nearly $20 billion. Furniture manufacturers, especially smaller firms, commonly market their products through independent sales representatives who provide information on the market, and get and service new retail accounts for manufacturers. Recently, some manufacturers have reduced their reliance on independent representatives by employing their own salespeople. Besides purchasing from manufacturers through independent sales representatives or the manufacturers' own sales staff, retailers may purchase furniture from wholesale furniture distributors. These wholesalers purchase from perhaps 25 to 30 manufacturers of different types and styles of furniture. The sales staff of the wholesalers then call on retailers within their areas. Dealing through local wholesalers that stock an assortment of furniture, and which also offer competitive prices, credit, and other services, is advantageous to many retailers, particularly smaller firms.[10]

Sales of furniture, bedding, and decorative accessories (including lamps and area rugs) by the top 100 furniture retailers totaled $20 billion in 1999. These firms accounted for 53 percent of the $37.2 billion in sales of these product categories by all furniture stores.[11] For the 68 conventional furniture stores in the top 100 furniture retailers, upholstered furniture accounted for about one-third of total sales. Approximately 30,000 establishments retail upholstered furniture. Larger retailers are more likely to purchase directly from furniture manufacturers, and smaller firms are more likely to purchase through wholesale distributors. Retail prices of upholstered furniture fall into a very broad range, depending on materials and manufacturing techniques used.

3.3. Upholstery Fabric / Materials

A review of trade publications and the American Textile Manufacturers Institute (ATMI) Directory of Manufacturers indicates that approximately 100 to 200 manufacturers derive a significant share of their revenues from fabric for household upholstered furniture. This number includes textile mills that produce finished upholstery fabric and textile finishers that purchase unfinished goods and perform additional operations, such as printing and dyeing. Interior fabric revenues of the top 16 firms totaled more than $3.5 billion in 2000, based on a survey done by *Furniture/Today*.

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[10] *Handbook of Furniture Manufacturing & Marketing, Volume 9, Wholesaling,* AKTRIN Research Institute and High Point University, May 1994.

[11] "The Top 100 Furniture Stores," *Furniture/Today*, Cahners Publishing, Greensboro, NC, May 22, 2000, pp. s4-s6.

These revenues included sales of fabrics other than those used in residential upholstery, which varied considerably, ranging from 10 percent of revenues for Quaker Fabrics to 60 percent for Covington Industries (among those firms for which sales break-outs were provided). [12] Based on a survey done in 1993, these firms might hold more than 80 percent of the total market for interior fabrics.[13] As with the upholstered furniture industry, recent years have seen consolidation of firms specializing in upholstery fabric production. Larger firms have bought out competitors or divisions of competitors, often retaining much of the existing production and management structure.[14]

Textile mills that make upholstery fabrics as their primary products are included in the North American Industry Classification System (NAICS) code, 313210. This code incorporates Standard Industrial Classification codes, SIC 2211 (Cotton Broadwoven Fabric Mills) and SIC 2221 (Manmade Fiber Broadwoven Fabric Mills). Of 909 establishments in NAICS 313210 in 1997, only 77 (8 percent) had more than 500 employees. More than half of the establishments had fewer than 20 employees.[15] The SBA considers establishments with fewer than 500 employees to be small businesses for the purposes of programs administered by the agency. Although these Census data are indicative of the sizes of establishments involved in the production of furniture upholstery fabrics, these codes encompass many firms that produce fabrics other than furniture upholstery.

Fabric finishers also tend to be small. Finishers are firms that receive unfinished fabrics ("greige goods") and perform additional manufacturing operations (*e.g.* printing, dyeing, backcoating, needle-punching, and stain-guarding). Fabrics may be purchased by the finishers, or finished under contract to other firms that supply the fabrics. Fabric finishers are classified in NAICS code 313311, which incorporated SIC 2261 ("Finishing Plants, Cotton") and SIC 2262 ("Finishing Plants, Synthetics"). Of 1,337 establishments in NAICS 313311, only 8 (0.6 percent) had more than 500 employees. [16] Only a few firms currently apply FR treatments to upholstery fabrics.

U.S. upholstery production in 1997 was 665.5 million square yards (or 444.7 million linear yards).[17] About 4,400 looms were in operation for the production of these fabrics. The major end-use markets for upholstery production are in upholstered furniture and automobile manufacturing. Upholstery fabrics are also used in the manufacture of window treatments and other home textiles. Based on a survey of upholstered furniture manufacturers by Keyser Ciprus, Ltd., we estimate that about 238

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[12] *Furniture/Today*, Cahners Publishing, Greensboro, NC, May 14, 2001, pp. 8-9.

[13] *Furniture/Today*, Cahners Publishing, Greensboro, NC, May 2, 1994, p. 8.

[14] *HFN The Weekly Newspaper for the Home Furnishing Network*, April 7, 1997, p. 114; and *Furniture/Today*, July 21, 1997, p. 38.

[15] U.S. Census Bureau, *1997 Economic Census, Broadwoven Fabric Mills, EC97M-3132A.*

[16] U.S. Census Bureau, *1997 Economic Census, Broadwoven Fabric Finishing Mills, EC97M-3133A.*

[17] U.S. Census Bureau data cited in "Textile Hilights," American Textile Manufacturers Institute, March 1997, p 10.

million linear yards of upholstery fabric were consumed in the production of household furniture in 1997.[18] This total does not include leather and vinyl upholstery, which we estimate to have comprised about 25 percent of all furniture upholstery materials used in 1997. Therefore, total upholstery use for the domestic manufacture of residential upholstered furniture was about 317 million linear yards. Estimates of total annual upholstery fabric consumption based on average requirements for chairs and sofas/loveseats are 230 million linear yards.[19]

The U.S. Census Bureau's 1997 Economic Census report, *Upholstered Household Furniture Manufacturing*, included information on the costs of upholstery fabrics and other materials used in the production of upholstered household furniture in 1997. The report placed the delivered cost of woven cotton upholstery fabrics (excluding ticking) at $360.7 million and the delivered cost of other woven upholstery fabrics (excluding ticking) at $505.3 million.[20]

3.3.1. Foreign Trade

Relatively little upholstery fabric is imported. A report by Keyser Ciprus, Ltd., estimates that 8 million linear yards of residential upholstery fabric were imported in 1997. This accounted for approximately 2 percent of total consumption of upholstery fabric for residential furniture production.[21]

Exports of upholstery fabric are significant for many U.S. manufacturers, including Rossville/Chromatex (a division of Culp), Burlington House, Dicey Fabrics, Microfibres, and Quaker Fabrics. Rossville/Chromatex exports about 40 percent of its production, according to a 1998 article in *Textile World*. Culp is also a significant producer of flocked fabrics (second to Microfibres), which are popular in Russia and other eastern European countries. *Textile World* reported that Burlington House, believed to rank in the top five among upholstery producers, exports about 18 percent of its upholstery production. Dicey Fabrics, a smaller firm that produces a diverse product line with jacquard and dobbie looms, reportedly exports about 20 percent of its production, some of which are printed flocks for which the greige goods are purchased. Microfibres is thought to be the world's largest manufacturer of flocked fabrics, and in the top five overall. Although exports were not reported, the popularity of these fabrics in Europe suggests that a significant percentage of Microfibres sales are exports. Another firm in the top five of

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[18] Keyser Ciprus, Ltd., *The 1997 North American Market for Contract & Residential Upholstery Fabric*, 1998. Keyser Ciprus reported that 166,649,250 linear yards of upholstery fabric were consumed by the surveyed upholstered furniture manufacturers in 1997. They further estimate that surveyed firms accounted for 70 percent of total fabric yardage consumed in the production of residential furniture.

[19] According to industry sources, an average of approximately 7 linear yards of fabric is needed to upholster chairs and 11 to 15 yards are needed for sofas. Based on about 30 million annual unit shipments (of which perhaps about 53 percent are sofas, sofabeds, and loveseats and about 47 percent are other chairs) estimated annual upholstery material requirements are about 305 million linear yards. About 75 percent of total yardage (about 230 million yards) would be fabrics that might require FR treatment.

[20] U.S. Census Bureau, *1997 Economic Census, Household Furniture, EC97M-3133A.*

[21] Keyser Ciprus Limited, *op. cit.*, p. 40.

fabric suppliers, Quaker Fabrics, testified before Congress in September 1997 that it exports more than $36 million of its fabrics, or 18 percent of its total sales. Based on this information, it appears that as much as 20 percent of the upholstery fabric production by U.S. manufacturers may be exported.

3.3.2. Characteristics of Upholstery Fabrics

CPSC-sponsored surveys of furniture manufacturers in 1981, 1984, and 1995, and a 1997 Keyser Ciprus, Ltd., survey of materials used, provided information on two characteristics of fabrics: *fabric type* and principal *fiber (or material) type*. *Fabric Type* refers to commonly-accepted descriptions of the ways in which fabrics are manufactured or of their distinctive characteristics. For the period covered by these surveys, manufacturers increased their use of jacquards and dobbies, and decreased their use of velvets.[22] Usage of cotton prints and flocks fluctuated within fairly narrow ranges during the period, according to the surveys.

Fiber (or material) Type refers to the fibers or materials used in the manufacture of the fabrics or upholstery. Most upholstery fabric fibers are classified as *cellulosic* (*e.g.* cotton and rayon) or *thermoplastic* (*e.g.*, polyester, polyolefin, and nylon); other materials used to make upholstery include vinyl (which is coated on a base fabric), wool, and leather. Based on the 1997 Keyser Ciprus survey, cellulosic fabrics currently account for an estimated 27 percent of upholstered furniture upholstery covering materials; thermoplastic fabrics account for 48 percent; leather and wool account for about 20 percent, and vinyl-coated fabrics account for about 5 percent.

Review of the data on material types from the four surveys conducted since 1981 indicates that the most notable changes over the last twenty years have been the increase in use of leather at the expense of both cellulosic and thermoplastic fibers.[23] The Keyser-Ciprus survey in 1997 found that about 20 percent of furniture covering materials used in 1997 was leather, significantly greater than found in the earlier surveys.[24] Fabrics made from predominantly cellulosic fibers include heavier-weight fabrics (such as cellulosic jacquards and velvets) and lighter-weight fabrics (mainly cotton prints). Heavier cellulosic fabrics comprised about 20 percent of fabric yardage in 1981 and 18 percent in 1984. The approximation of heavier-weight cellulosic fabrics' share from 1995 survey data is about 14 percent, suggesting a decline in use of these fabrics, which generally

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[22] "Jacquards" and "dobbies" refer to the types of looms and weaves used to produce fabrics. Brocades, damasks, velvets, tapestry weaves, and matelasses are often jacquard-woven. Dobbie looms enable weaving of small, geometric figures as a regular pattern. Dobby looms produce patterns that are beyond the range of simple looms, but are somewhat limited compared to a jacquard loom, which has a wider range of pattern capabilities.

[23] Although wool was included with leather in CPSC-sponsored surveys, articles in the trade press confirm that leather has been increasing in use, and it is likely that most of the increase seen in the category is attributable to greater use of leather.

[24] Wool, included with leather in previous CPSC survey reports, was not used by any of the furniture manufacturers surveyed by Keyser Ciprus.

show less resistance to cigarette ignition.[25] Using data from the Keyser-Ciprus survey, we estimate that 13 percent of upholstery covering materials used in 1997 were heavier cellulosics.

4. CHARACTERISTICS OF FURNITURE IN U.S. HOUSEHOLDS

4.1. Numbers of Units in Use

The number of furniture units in use is estimated with the CPSC Product Population Model, based on available annual sales data and industry estimates of the average product life of furniture. Estimates are for sofas, loveseats, armchairs, recliners, convertible sofas and other upholstered furniture commonly found in residential living rooms, family rooms, and guest rooms. Other types of upholstered chairs (desk chairs and dining chairs) are discussed elsewhere in this report.

Sales are defined as shipments from U.S. manufacturers plus net imports. Annual shipment data are available from the *Census of Manufactures* published every five years (*i.e.*, 1997, 1992, 1987, ...) by the Bureau of the Census. For upholstered wood furniture and dual-purpose sleep furniture, the *Census of Manufactures* provides information on unit shipments, by type (such as sofas, sleep sofas, rockers, recliners, and other chairs). For some firms, the *Census* only reports values of shipments (usually averaging about 15 percent of total value of shipments for each *Census* year), and the production of these firms is reported as being "Not Specified by Kind." Also, for upholstered living room furniture on metal, reed, and rattan frames, and some wood upholstered product categories, values of shipments, but not unit shipments, are provided. For these unreported categories, we estimated unit shipments by assigning average per unit values to the *Census* data on value of shipments. Finally, estimates of net imports were added to shipments to estimate the total number of upholstered units sold to U.S. households.

For the years in which *Census of Manufactures* data are not available, shipment estimates were based on furniture shipment values published by the Department of Commerce in the *Annual Survey of Manufactures*. For example, we estimated that U.S. households purchased a total of 24.3 million new units of upholstered furniture in 1987 based on *Census* data. Although unit shipments were not reported for 1988, the real value of shipments reported for that year in the *Annual Survey of Manufactures* was 1.6 percent below the 1987 level. Assuming unit shipments also fell by that amount, estimated total consumer purchases were 23.9 million units in 1988.[26]

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[25] However, discrepancies in answers of three respondents may have led to an underestimation of the weighted average share of heavier cellulosic fabrics. Analysis of responses without contradictory responses shows the average share of heavier cellulosic fabrics to be about 17 percent for 1995.

[26] For years prior to 1967, changes in the annual furniture production index (maintained by the Federal Reserve) were considered in estimating unit shipments.

The CPSC's Product Population Model uses sales data and information on the average product life to estimate the numbers of items remaining in use in the years following their purchase by consumers. The estimated average useful life of upholstered furniture reportedly ranges from 15 to 17 years.[27] Using this range yields an estimate of about 384 to 428 million pieces of residential living room and family room furniture in use during the 1995-1998 time frame, the most recent 4-year period for which furniture fire hazard data are available.[28]

4.2. Upholstery Covering Materials on Furniture in Household Use

Surveys of furniture manufacturers in the last 20 years show the shift towards thermoplastic fabrics peaked during the period of the mid-1980's to the mid-1990's. Information provided to the CPSC by the Upholstered Furniture Action Council (UFAC) showed that a significant shift to greater use of thermoplastic fabrics began in the 1950's, and became more pronounced in the 1970's.[29] These data on usage of different types of fabrics over the years can be used to characterize upholstery fabrics found on furniture in U.S. households. An estimated 37 percent of furniture in use in American households during the period 1995-1998 was covered with predominantly cellulosic fabrics; about 52 percent with predominantly thermoplastic fabrics, and about 11 percent with other materials (mainly leather, wool, and vinyl-coated fabrics).

5. EXPECTED BENEFITS OF A STANDARD

The expected benefits of the draft standard are calculated in four steps. First, the average annual societal cost of fires per unit of furniture in use that would be addressed by the draft standard is estimated. This average annual cost is based on estimates of the aggregate annual costs of fire-related deaths, injuries, and property damage, and the number of furniture products in use.

Second, since each furniture item is expected to remain in use for an average of 15 to 17 years, the present value of the product's estimated lifetime fire costs is estimated by summing the discounted annual costs over the item's expected useful life. (This estimate represents the maximum potential benefits of the standard per unit of furniture in use, assuming that all fires could be prevented.)

The estimated annual costs that are expected to accrue over the furniture item's useful life are discounted at an annual rate of 3 percent. This rate is consistent with recommendations in the economic literature for discounting the costs and consequences of health programs.[30] However, to show the sensitivity of the results to the 3 percent

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[27] Based on discussions between industry officials and Department of Commerce personnel.

[28] The time frame of available hazard data since 1994 was chosen to reflect years in which the CPSC cigarette lighter standard has been in effect, so that the small open-flame hazard would not be overstated.

[29] Report to the CPSC on the UFAC Voluntary Program, Upholstered Furniture Action Council, March 21, 1978.

[30] For example: Viscusi, W.K., "Discounting Health Effects for Medical Decisions," in *Valuing Health Care: Costs,*

discount rate, societal costs are also discounted at a rate of 0 percent (*i.e.* undiscounted) and 7 percent.

Third, the expected percentage reduction in fires is estimated. As discussed below, CPSC laboratory testing of upholstered chairs covered with untreated upholstery fabrics and with fabrics treated with FR chemicals (and which passed the small open flame mockup test) provide data on effectiveness.

Finally, to estimate expected reduction in the fire costs associated with the rule (i.e., the estimated benefits), the present value of expected per unit fire costs is multiplied by the expected percentage reduction in fires.

It should also be noted that the draft standard is expected to reduce fires ignited by cigarettes as well as by small open flames. Consequently, the expected benefits associated with preventing fires from both small flames and cigarette ignitions are considered below.

5.1. Expected Benefits from Reducing Open-Flame Ignited Fires

5.1.1. Societal Costs of Small Open-Flame Fires

Aggregate estimates of upholstered furniture fire losses from small open-flame ignitions for the years 1995 through 1998 have been estimated by the Commission's Directorate for Epidemiology.[31] During this time period, there were an average of 55 deaths and 375 nonfatal injuries annually from fires started by small open flames. There was also an average of about $32.7 million annually in property losses from small openflame-ignited fires during this time frame. By combining the costs associated with deaths, injuries, and property damage total societal costs can be estimated.

While the Commission does not endorse any measure of the value of life, for analytic purposes staff assigned a statistical value of $5 million for each death. The $5 million estimate is consistent with the general range of the statistical value of life published in the literature, which generally falls in the $3 million to $7 million range.[32] Multiplying the annual estimate of about 55 deaths by the cost of $5 million per death yields an annual fatality cost of $275 million.

Benefits, and Effectiveness of Pharmaceuticals and Medical Technologies, ed. F.A. Sloan, 123-24. New York: Cambridge University Press. 1995. Also, Gold, Marthe R., *et. al.*, *Cost-Effectiveness in Health and Medicine*. New York: Oxford University Press. 1996.

[31] Ault, Kimberly, and Levenson, Mark, "Upholstered Furniture Fire Losses 1980-1998," Directorate for Epidemiology, U.S. Consumer Product Safety Commission, December 2000.

[32] Viscusi, W. Kip, "The Value of Risks to Life and Health," Journal of Economic Literature, Vol. XXXI, December 1993, pp. 1912-1946.

Nonfatal injuries were assigned an average cost of $170,000 each. The basis for this estimate was the analysis of burn injury costs reported in the August 1993 report "Societal Costs of Cigarette Fires," part of the research sponsored by the CPSC under the Fire Safe Cigarette Act of 1990.[33] The $170,000 figure represents a weighted average of injury costs (including pain and suffering) for both hospitalized injuries and injuries treated and released. The estimate of 375 injuries annually results in societal costs of about $63.8 million.

As noted earlier, the draft standard would also address $32.7 million annually in property losses from fires started from small open-flame ignitions. Consequently, the total annual costs of open-flame ignited fires addressed by the draft standard amount to about $372 million ($275 million + $63.8 million + $32.7 million). The estimate of $372 million in societal costs represents the potential benefits of eliminating all small open-flame-ignited fires determined to be addressable by the standard.[34]

Information on the number of furniture items (*i.e.*, separate pieces of furniture) in use provides a basis for estimating the costs of small open-flame fires on a per unit basis. As noted above, by using the CPSC's Product Population Model in combination with historical upholstered furniture shipment data and available information on the expected product life of furniture, we estimated that the four-year average number of units in use during the 1995-1998 time period ranged from about 384 million to 428 million, based on an average product life of 15 to 17 years. For the purposes of the analysis, we assume an average of 406 million units of residential living room and family room furniture were in use during the period. However, because about 11 percent of these furniture items were covered with materials that tend to be fire resistant (such as wool, leather, and vinyl), only about 361 million (0.89 x 406 million) items were covered with fabrics that would be addressed by the draft standard.

This suggests hazard costs of about $1.03 per unit of furniture in use per year ($372 million / 361 million units).[35] Since furniture has an average product life of about 15 to17 years, the annual hazard costs of about $1.03 accrue over a number of years. The expected present value of these societal costs, over the expected useful life of the furniture products (at a discount rate of 3%) averages $12.51.[36]

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[33] Miller, Ted R., et. al., "Societal Costs of Cigarettes Fires," prepared for the U.S. Consumer Procduct Safety Commission under the Cigarette Safety Act of 1984, August 1993.

[34] It should be noted that the estimate of total societal costs does not include additional societal costs totaling $62.4 million annually estimated to result from other small open-flame fire sources that might potentially be addressed by the standard. The Directorate for Epidemiology analysis (Ault and Levenson, 2000) found that other heat sources potentially addressed by the small open-flame standard include sparks, embers, or flames escaping from fueled equipment, arcs or sparks from electrical equipment, small torches, hot embers, and fireworks. Annual upholstered furniture fire losses from such ignition sources in 1995-1998 averaged about 10 deaths, 37.5 injuries, and $6.1 million in property damages.

[35] Based on the average for the estimated range in expected product life of 15-17 years; the estimated hazard costs per unit per year ranges from $.98 for a 17-year product life to $1.09 for a 15-year product life.

[36] Based on a 16-year expected product life. Corresponding expected present value of hazard costs are $12.44, for a 17-year expected product life, and $12.64, for expected product life of 15 years.

5.1.2. Reductions in Ignition Propensity Under the Draft Standard

Estimates of the expected reduction in small open-flame ignited fires resulting from the draft standard are based on CPSC laboratory testing of the ignition propensity of chairs covered with both treated fabrics (i.e., fabrics treated to meet the seating area test requirements of the standard) and untreated fabrics. In general, the percentage reduction in the ignition propensity can be estimated as: (IPu-IPt)/IPu, where IPu represents the ignition propensity of untreated fabrics (*i.e.*, the proportion of tests on chairs covered with untreated fabrics that resulted in ignition and combustion, without self-extinguishing) and IPt represents the ignition propensity of treated fabrics.

In a 1995 study of full-scale small open flame testing of chairs covered with untreated fabrics, the CPSC engineering laboratory found that all test flame applications on nine chairs resulted in ignitions. Eight of the chairs were covered with predominantly cellulosic fabrics and one was covered with a thermoplastic fabric.[37] Although only one chair covered with thermoplastic fabric was tested, extensive testing of mockups with 29 cellulosic fabrics and 18 thermoplastic fabrics showed that the average ignition propensity of thermoplastic fabrics is comparable to that of cellulosic fabrics when subjected to 20-second exposures to small open flames.[38]

A total of 21 chairs covered with FR-treated fabrics that passed the seating area small open flame mockup test of the CPSC standard previously had been subjected to full-scale testing by the engineering laboratory in its UK chair study done in 2000. Twelve of these chairs were covered with predominantly cellulosic fabrics and nine were covered with predominantly thermoplastic fabrics. Each chair was subjected to six flame applications. These ignition tests found that about 12 percent of flame applications resulted in ignitions.[39]

Thus, assuming this limited testing is representative of ignition rates for treated and untreated cellulosic and thermoplastic fabrics, the reduction in the average ignition propensity (based on individual flame ignition tests) would be about 88 percent [$(IP_u - IP_t)/IP_u = (1.0 - 0.12)/1.0$]. Statistical analysis of the testing data found that the 95 percent confidence interval around this estimate is plus-or-minus 12 percent. Thus, the lower bounds of the reduction in ignition propensity resulting from the standard would be 76 percent.[40]

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[37] Fansler, Linda, *et. al.*, Directorate for Laboratory Sciences, CPSC, "Upholstered Furniture Flammability Testing: Full Scale Open Flame Data Analysis," February 26, 1996.

[38] Directorate for Laboratory Sciences memoranda dated October 3, 1996, through September 19, 1997, Attachment B, "Regulatory Options Briefing Package on Upholstered Furniture Flammability," October 28, 1997.

[39] Levenson, Mark, Ph.D., Division of Hazard Analysis, Directorate for Epidemiology, CPSC, "Statistical estimation of the reduction in fire losses from adoption of the CPSC draft small open-flame standard," August 2001.

[40] *IBID.*

5.1.3. Estimated Benefits from Reducing Small Open-Flame Ignited Fires

As noted previously, the discounted average expected societal costs of small open flame-ignited fires was estimated to be about $12.51 per unit of furniture over its expected product life (discounted at 3 percent). Based on CPSC laboratory ignition tests, the draft standard is estimated to reduce small open-flame ignited fires by 88 percent. The best estimate of expected benefits of the draft standard may therefore be about $11.01 ($12.51 x .88) per unit of furniture. The lower bounds of the confidence interval is a reduction of small open-flame ignited fires by 76 percent, with estimated benefits of about $9.51 ($12.51 x .76) per unit of furniture.

The results of the calculations of benefits from small open-flame ignition hazard reduction are shown in Table 1:

Table 1. Estimated Benefits from Small Open-Flame Ignition Reduction

	Best Estimate	Lower Bounds of 95% Confidence Interval
Expected Lifetime Hazard Costs per Unit Addressed by Furniture Standard	**$12.51**	**$12.51**
Projected Hazard Reduction (Percent)	**88%**	**76%**
Estimated Lifetime Benefits per Unit of Furniture	**$11.01**	**$9.51**

5.2. Expected Benefits from Reducing Cigarette Ignited Fires

5.2.1. Societal Costs of Cigarette Ignited Fires

In addition to benefits associated with reductions of fires started from small open flames, the draft standard would also result in a reduction in upholstered furniture fires started by cigarettes. This conclusion is based on laboratory testing results of fabrics that have been treated to comply with the testing specified in the existing UK regulation. Also, as noted by the Directorate for Engineering Sciences, the provision in the standard limiting progression of smoldering combustion following the application of a small open

flame in the seating area test indirectly addresses the smoldering combustion hazard presented by cigarettes and other smoldering ignition sources.[41]

During the 1995-98 time period, according to the Directorate for Epidemiology, there was an average of about 443 deaths and 805 nonfatal injuries annually that resulted from fires started by cigarettes. Additionally, there was an average of about $90.5 million annually in property losses during this time frame.[42] With a societal cost of $5 million per death and $170,000 per injury, the societal costs of the fires started by cigarettes amounts to about $2,440 million annually (442.5 deaths x $5 million + 805 injuries x $170,000 + $90.5 million in property losses).

While both cellulosic and thermoplastic fabrics are susceptible to cigarette ignition, laboratory testing by the CPSC shows the ignition propensity of cellulosic fabrics is much higher. This suggests that the great majority of cigarette fires involve cellulosic fabrics. Based on the results of CPSC testing, an estimated 93 percent of the fires started with cigarettes during 1995-98 involved the estimated 37 percent of furniture items covered with cellulosic fabrics. The remaining 7 percent of cigarette fires involved the estimated 52 percent of furniture items in use during that period that were covered with thermoplastic fabrics.[43] Other materials, such as leather, vinyl, and wool, are believed to account for a negligible proportion of fires, because of their very high resistance to ignition from cigarettes.

Since there were an estimated average of 406 million living room and family room furniture items in use during the 1995-98 study period, the annual expected fire costs for furniture covered with cellulosic fabric was about $15.11 per item ([$2,440 million x 93%]/[406 million items x 37.0%]). The present value of these expected fire costs over the life of a furniture item (at a 3 percent discount rate) amounts to $183.54 per unit.

Similarly, the annual expected fire costs of thermoplastic-covered furniture was about $.81 per unit ([$2,440 million x 7%]/[406 million furniture items x 51.9%]). The present value of these costs, over an average product life of 15-17 years, is $9.84 per unit.

When the annual expected fire costs of cellulosic and thermoplastic fabrics are weighted by the current market shares of fabrics being used (for purposes of estimating the benefits of preventing cigarette fires in the future), the average annual societal costs were about $5.95 per furniture item.[44] The present value of these hazard costs, over an

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[41] Khanna, Rohit Z., Directorate for Engineering Sciences, CPSC, *Cigarette - Open Flame Relationship*, October 23, 2001.

[42] Ault, Kimberly and Levinson, Mark, Directorate for Epidemiology, CPSC, *op. cit.*, December 2000.

[43] Proportions of cigarette-ignited fires accounted for by cellulosic and thermoplastic fabrics were calculated by weighting CPSC laboratory cigarette test data ignition rates (for individual cigarette tests) for cellulosic and thermoplastic fabrics by their estimated shares of fabrics on furniture in use during 1995-98.

[44] This is estimated as: [(.269)($15.11) + (.480)($.81)]/.749, where .269 and .480 represent the market shares of cellulosic and thermoplastic fabric coverings, respectively.

average product life of about 15 to 17 years and at a 3 percent discount rate, is $72.22 per unit.[45]

Implicit in the estimate of hazard costs of $72.22 per unit is the assumption that the incidence of cigarette-ignited fires will remain constant at the 1995-98 level (adjusted to account for ignition propensity of current fabrics used in the manufacture of furniture). Available data suggest that additional factors (other than changes in fabrics) have contributed to a decline in fires resulting from cigarette ignition of upholstered furniture over time.[46] These factors include changes in smoking-related behavior of individuals, increased presence of smoke detectors, and changes in furniture filling materials. The present value estimate was further adjusted to account for an expected future decline in smoking-related fire incidents. This was done by forecasting future fire deaths by year, based on trends during the 1980-1998 time period,[47] and reducing the expected societal costs of cigarette ignited fires by the projected percentage reduction. This adjustment reduced the estimated present value of the societal costs of cigarette ignited fires from *$72.22 per unit to $62.74 per unit.*

5.2.2. Reduction in Ignition Propensity Under the Draft Standard

As in the case of fires started by small open flames, the expected reduction in fires started with cigarettes is based on CPSC laboratory full-scale ignition testing of chairs covered with both treated and untreated fabrics. The reduction in the ignition propensity is estimated as (IPu-IPt)/ IPu, where IPu represents the cigarette ignition propensity of current furniture produced in the absence of a standard and IPt represents the ignition propensity of furniture covered with fabrics that pass the seating area test of the standard.

The CPSC's engineering laboratory conducted cigarette ignition tests on 16 chairs covered with untreated cellulosic fabrics in 1984 and 34 chairs with untreated cellulosic fabrics in 1994 as part of its evaluation of the effectiveness of the UFAC Voluntary Program.[48] The laboratory also conducted cigarette ignition tests on 24 chairs covered with untreated thermoplastic fabrics in 1984 and 22 chairs covered with untreated thermoplastic fabrics in 1994. Generally, nine to twelve cigarettes were tested on chairs; three at each of the locations subjected to testing: the back and side crevices, the flat surface of the seat cushions, and the welt edge (if present).

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[45] Based on 16 year product life; the present value of weighted average per unit hazard costs ranges from $70.22 (17 years) to $74.12 (15 years).

[46] Ault and Levenson, *op. cit.*, February 2001.

[47] Annual estimates of future fire deaths were forecasted with a first-order autoregressive time series model. The dependent variable was defined as the natural log of the smoking materials fire deaths reported in Table 4 of Ault and Levenson, February 2001.

[48] Fairall, Patricia, Directorate for Engineering Sciences, CPSC, "Analysis of CPSC 40 Chair Test Program," May 1984 (1984 chair test results) and Charles Smith, EC and Linda Fansler, LSEL, Cigarette Ignition Propensity of Upholstered Furniture, November 1996 (1994 chair test results).

Based on the full-scale laboratory testing, the mean percentage of individual applications of test cigarettes igniting on chairs was about 25.7 percent for chairs covered with untreated cellulosic fabrics, and about 1.4 percent for chairs covered with untreated thermoplastic fabrics. Assuming the remaining types of fabrics are ignition resistant (*e.g.*, wool, leather, vinyl), the ignition propensity for untreated fabrics (IPu), weighted by current market shares, was about 10.1 percent.[49]

The full-scale testing perfomance of the 21 chairs covered with FR-treated fabrics (and which passed the draft CPSC seating area test) is indicative of the cigarette ignition propensities of furniture that would comply with the standard. These chairs were subjected to 7 to 11 test cigarettes. The average ignition rate from test cigarettes for the 12 chairs with treated cellulosic coverings was 6.4 percent; the average ignition rate from test cigarettes on the 9 chairs with treated thermoplastic fabrics was 0 percent. This yielded an average propensity of ignition for treated fabrics (IPt) of about 2.3 percent.[50]

Thus, if we assume this limited testing is representative of actual ignition rates for treated and untreated cellulosic and thermoplastic fabrics, the estimated reduction in ignition propensity (based on individual flame ignition tests) would be about 77 percent [(IPu-IPt)/IPu = (.101-.023)/.101]. Statistical analysis of the testing data found that the 95 percent confidence interval around this estimate is plus-or-minus 27 percent. Thus, the lower bounds of the reduction in ignition propensity resulting from the standard would be 50 percent.[51]

5.2.3. *Estimated Benefits from Reducing Fires Started with Cigarettes*

As shown earlier, the average expected societal cost of fires started with cigarettes is estimated to be about $62.74 per unit of furniture over its expected product life. CPSC laboratory ignition tests lead to a best estimate of reduced ignition propensity of 77 percent. The lower bounds of the 95 percent confidence interval is a reduction of 50 percent. The expected present value of benefits of the draft standard, using a 3 percent discount rate, may therefore be about $48.31 ($62.74 x .77) per unit of furniture, with a statistical lower bounds of about $31.37 ($62.74 x .50) per unit of furniture. The results of the calculations of benefits from cigarette ignition hazard reduction are shown in Table 2.

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[49] IPu = [(.257 X.269) + (.014 X.480)]/.749 = .101.

[50] IPt = [(.064 X.269) + (0 X.480)]/.749 = .023.

[51] Levenson, Mark, Ph.D., *op.cit.*

Table 2. Estimated Benefits from Reduction in Cigarette Ignitions

	Best Estimate	Lower Bounds of Confidence Interval
Expected Lifetime Hazard Costs per Unit of Furniture Addressed by the Standard	**$62.74**	**$62.74**
Projected Hazard Reduction (Percent)	**77%**	**50%**
Estimated Lifetime Benefits per Unit of Furniture	**$48.31**	**$31.37**

5.3 Summary and Sensitivity of Expected Benefits to the Discount Rate

As noted previously, the values of the expected hazard reduction accruing over the life of an item of furniture have been expressed as a present value by discounting the hazard costs and benefits at an annual rate of 3 percent. This yielded average per unit benefits of $9.51 to $11.01 in the prevention of small open-flame fires and $31.37 to $48.31 in the prevention of cigarette ignited fires.[52] The average total benefits per unit of furniture is, therefore, about $59.32, based on the "best estimates" of open flame and cigarette benefits. Combining the estimated lower bounds of the 95 percent confidence intervals for the estimated reductions in open flame and cigarette ignition propensities yields per unit benefits as low as $40.88. (The results of these calculations are shown in Table 3).

In order to evaluate the sensitivity of these results to the discount rate used, we also estimated the benefits using a discount rate of 0 percent (*i.e.*, undiscounted) and 7 percent. If the expected benefits had not been discounted at all, the average estimated benefits of the standard would have ranged from $12.91 to $14.95 in the prevention of small open-flame fires and $41.94 to $64.87 in the prevention of cigarette ignited fires. As shown in Table 3, the average estimated total benefits per unit of furniture, if undiscounted, would have been $54.85 to $79.54, an increase of about 34 percent when compared to a 3 percent discount rate. In contrast, if the expected benefits had been discounted at a rate of 7 percent, the average estimated benefits of the standard would have ranged from $6.80 to $7.88 in the prevention of small open-flame fires and $22.83 to $35.16 in the prevention of cigarette ignited fires. The average total benefits, per unit of

[52] The lower values are based on the estimated lower bounds of the 95% confidence intervals. The higher value are based on the "best estimates."

furniture, would have been $29.63 to $43.03, a decrease of about 27 percent when compared to the benefits at a 3 percent discount rate.

Table 3. Estimated Average Per Unit Benefits From the Draft Standard, At Alternative Discount Rates

RATE	BENEFITS FROM REDUCTION IN SMALL OPEN-FLAME FIRES		BENEFITS FROM REDUCTION IN CIGARETTE IGNITED FIRES		COMBINED BENEFITS	
	Lower Bound Estimate	Best Estimate	Lower Bound Estimate	Best Estimate	Lower Bound Estimates	Best Estimates
0%	$12.91	$14.95	$41.94	$64.87	$54.85	$79.82
3%	$9.51	$11.01	$31.37	$48.31	$40.88	$59.32
7%	$6.80	$7.88	$22.83	$35.16	$29.63	$43.04

5.4 Barrier Material Alternative

The standard allows manufacturers to use upholstery fabrics, including those that may not comply with the seating area test, to be used over materials that pass the barrier test. Although these barrier materials would not prevent upholstery fabrics from igniting and continuing to burn, limited testing data indicate that barriers would effectively reduce fire growth. Barriers could also result in a reduction in fire growth if ignition sources other than small open flames or cigarettes are involved, or in scenarios in which furniture is not the first item ignited. The reduction in deaths, injuries, and property damage that would result from the use of the barrier alternative is uncertain. However, for the purposes of this analysis we assume that the use of barriers would lead to reductions in fire losses from ignitions of upholstered furniture that are roughly equivalent to benefits from FR treatment of upholstery fabrics.

6. POTENTIAL COSTS

6.1. Compliance with the Seating Area Test

The most likely means of compliance with the draft CPSC standard would be the use of fire retardant (FR) chemicals in upholstery fabrics. The seating area test of the draft standard is very similar to that prescribed by the "match test" provisions of the UK furniture regulations. Therefore, the costs associated with the UK regulations are indicative of the possible costs of the draft U.S. standard.

6.1.1. FR Treatment of Upholstery Fabrics

A number of fabric manufacturers, including some major U.S. fabric companies, have been producing fabrics that comply with the UK match test. Means of compliance with this test include backcoating with FR chemicals, applying FR chemicals to the fabric using an immersion method, or incorporating FR chemicals into the fibers that are used to make upholstery fabrics. FR backcoating is reportedly the dominant method used in the UK.

Information on the costs of the various FR treatments is available from several sources. According to information provided by officials with the leading backcoating fabric finisher in the UK and a major UK upholstered furniture manufacturer, the increased cost to the furniture manufacturer to have fabric shipped to a fabric converter for FR backcoating is about $.71 to $1.14 per linear yard of fabric, including inspection and transportation.[53] This is in line with information provided by an official with a U.S. backcoating firm, who informed us that their average charge to FR backcoat is about $1.00 per linear yard.[54]

Based on information provided by fabric and furniture manufacturers contacted, perhaps 60 percent or more of upholstery fabric yardage used in the manufacture of furniture in the U.S. is backcoated routinely for other purposes. Therefore, the $.71 to $1.14 cost range described above overstates the average incremental costs that would be incurred for most fabrics under the standard. Costs of normal (non-FR) backcoating for such fabrics reportedly ranges from $.05 to $.30 per linear yard.[55] If we assume that non-

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[53] Conversations in August 2000 with David Hawkridge of Mobeltest (a division of Christie-Tyler, Ltd., a major UK upholstered furniture manufacturer) and Roger White, President, Clarkson Textiles. Mr. Hawkridge estimated average costs of .70-.80 GBP per running meter and Mr. White reported charging .50-.60 GBP for most fabrics, but up to .80 GBP for fabrics requiring more backcoating. The annual average currency conversion rate was 0.64 British Pounds/US Dollar. Conversion from meters to yards is 1 meter = 1.0936133 yards. Therefore, equivalent "running yard" costs = (.50GBP/.64)/1.0936133 = $.71 to (.80GBP/.64)/1.0936133 = $1.14.

[54] Charles Smith, Directorate for Economic Analysis, CPSC, July 2000 telephone conversation with Tom Applegate, Resistflame Finishing Company.

[55] Costs of 5-25 cents for normal backcoating were provided by David Pettey, Director of Quality for Quaker Fabric Corporation in a June 12, 1998, letter to the Directorate for Economic Analysis. Costs of 25-30 cents for normal backcoating in large runs were provided by Tom Applegate of Resistflame Finishing Company in an August 31, 2000,

FR backcoating costs an average of about 15 cents per linear yard, and conservatively assume that 60 percent of fabrics are currently backcoated, the average incremental cost increase faced by furniture manufacturers for FR-backcoated fabrics would be $.62 to $1.05 per linear yard.[56]

While backcoating is the predominant FR treatment method used in the UK, chemical immersion treatments are also used on some cellulosic fabrics. Based on estimates of the British Interior Textiles Association (BITA), treatment with FR chemicals not incorporated in backcoating generally adds about $1.14 to $1.37 per linear yard of fabric. Other estimates by a major upholstered furniture manufacturer in the UK, responding on behalf of the trade organization of furniture manufacturers, British Furniture Manufacturing, indicate that costs of chemical immersion treatments typically range from about $.72 to $1.06 per linear yard of fabric at average 1999 currency exchange rates.

In summary, the British and American experience with a small open-flame testing requirement suggests that average increased fabric costs to U.S. furniture manufacturers would generally fall in the range of $.62 to $1.05 per linear yard.

6.1.2. Upholstery Fabric Testing Costs

The draft standard includes a sampling plan, which initially calls for three segments (requiring a total of about 6.7 linear yards) to be sampled from fabric production runs of 50-1,000 linear yards (with additional samples required for production runs longer than 1,000 yards). Segments are to be cut from the beginning, middle, and end of production runs. Each of the three segments would provide fabric to conduct four seating area tests. If any of the twelve seating area tests result in ignitions, as defined by the standard, four additional tests are to be done from an additional segment adjacent to the one that included the sample that ignited. If all four tests from the additional sample pass, the production run is considered to have passed. If passing results are achieved for five consecutive production runs, the sampling plan allows for reduced sampling in subsequent production runs (two samples and eight tests for production runs of up to 5,000 yards). If passing results at that sampling frequency are achieved in five consecutive production runs, subsequent runs may be sampled at further reduced rates (two samples and eight tests for production runs of up to 10,000 yards). Fabric suppliers would incur costs related to this testing and we would expect these costs to be passed on to furniture manufacturers and consumers.

The largest fabric finisher in the UK provided detailed information on the frequency of testing under the UK regulations. This firm backcoats fabrics supplied by

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telephone conversation with Charles Smith, Economic Analysis, CPSC.

[56] Based on $.15 per yard for backcoating for other purposes, incremental costs would range from $.56 to $.99 per yard. Average costs based on 60% of fabrics being backcoated for other purposes is therefore calculated by: ($.56 x 60%) + ($.71 x 40%) = $.62 to ($.99 x 60%) + ($1.14 x 40%) = $1.05

fabric manufacturers, including U.S. companies. Production runs are comprised of fabrics of similar weight and fiber contents, and might include 20 fabric patterns provided by 10 different fabric suppliers. Production runs of 5,000 to 10,000 linear meters (about 5,470 to 10,940 yards) are typical for this firm. Samples of fabrics are tested once at the beginning of each run, and every 500 meters up to 5,000 meters. Thereafter, if all tests had passing results, samples are tested every 1,000 meters for the remainder of the production run. Based on this type of testing program, testing might be done on about 10 samples in a 5,000-meter backcoating run, and 15 samples in a 10,000-meter run.

Based on the information provided by the UK firm, the average length of fabric types joined together in a backcoating run may be in the range of 275 to 550 yards. If backcoating runs under the draft CPSC standard also would be comprised of about 20 different fabric types, perhaps 134 yards of fabric would be required for testing under the initial sampling plan (6.7 linear yards x 20 fabric types). The nearly seven yards per fabric type would comprise about 1 to 2 percent of the treated fabric, on average. In order for fabric suppliers to maintain revenues from their production, they would have to increase prices to furniture manufacturers by about 1 to 2 percent per yard. According to a report on fabric consumption by the upholstered furniture industry, the average price per yard of fabric was $5.23 in 1997.[57] Based on this, the average increase per yard of fabric to furniture manufacturers due to fabric requirements for testing may be about $.06 to $.13 per yard.[58]

According to the director of the major UK testing laboratory, each seating area test could cost about $70.[59] However, a limited sample of U.S. fabric manufacturers who have had testing done by independent laboratories found that test costs ranged from $140 to $150 per test. Assuming that 12 tests would be done on average every 275 to 550 linear yards of fabric produced or treated, testing costs would range from about $840 (12 x $70) to $1,800 (12 x $150). The average cost of testing would range from about $1.53 to $6.55 per linear yard.[60]

The high costs of testing at independent testing facilities make it likely that most testing would be done at testing facilities at fabric manufacturing or FR treatment establishments. An official with the largest backcoating firm in the UK advised us that a backcoating line is capable of coating more than 50,000 linear meters (54,681 linear yards) per 40-hour shift. They have one employee on each of three shifts who is primarily responsible for testing to the UK regulations; most of these employees' time is devoted to testing and preparation of reports. Under the CPSC's initial sampling plan in the draft standard, considerably more labor time would be needed to conduct the testing. If 12 tests are done on every 275 to 550 yards of fabric, on average, about 1,200 to 2,400 tests

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[57] Keyser Ciprus, Ltd., *op. cit.*

[58] $5.23 x 1.2% = $.06; $5.23 x 2.4% = $.13

[59] Based on 40 UK Pounds per test (per an August 8, 2000, telephone conversation with David Hawkridge of Mobeltest), plus approximately $10 in fabric costs.

[60] $840/550 yards = $1.53 per yard; $1,800/275 = $6.55 per yard.

2,400 tests might be required in a 40-hour shift, or about 240 to 480 per day per shift.[61] If fabrics are tested at the reduced rate allowed by the sampling plan, testing would be reduced by one-third, to perhaps 160 to 320 tests per day per shift. The major U.K. backcoating firm stated that most of the time of one employee was needed to conduct tests and prepare reports, for what we estimate to be perhaps 15 to 20 tests per day per shift. If we assume that 10 full-time employees would conduct all of the necessary testing, weekly testing labor costs may be approximately $8,000 per shift (based on $20 average hourly rate for testing technicians' salary and related expenses). These testing costs would amount to about $.15 per linear yard of fabric.

Based on fabric required and personnel needed to conduct testing, we estimate that the initial testing frequency specified in the sampling plan of the proposed standard may involve total costs on the order of $.21 to $.28 per linear yard.[62] These costs would decline if production runs were lengthened or reduced sampling is required as a result of passing testing results on consecutive production runs.

The proposed sampling plan provides relief to fabric suppliers that require the treatment of small lengths of fabric (under 50 linear yards). Although these fabrics are not subject to the sampling plan, they still would be expected to comply with the standard.

The amount of testing that would be done on inherently ignition resistant upholstery materials is not clear. Wool fabrics and vinyl-coated fabrics, for example, are generally expected to pass the seating area test without modifications. Other fabrics that are inherently ignition resistant currently are used in other markets, and these may be come economically viable for the residential furniture market under a mandatory standard. Such materials would be expected to be subject to reduced testing eventually under the sampling plan. In the case of vinyl-coated fabrics, testing costs for eight samples in their production runs (that are much longer than FR-treatment production runs) should be minimal. Leather upholstery also is inherently ignition resistant; however, given the definition of the length of a production run requiring sampling, specific sampling for leather is not specified by the standard. Testing could be infrequent if tanneries and furniture manufacturers became confident that leather would consistently pass.

The draft standard includes a requirement to maintain sufficient finished fabric samples to repeat the fabric sampling procedure for a period of three years or more. This requirement is similar to the requirement in the CPSC's Children's Sleepwear Standard. This would increase material costs, and would have other costs associated with sample

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[61] (54,681 yards per shift per week / 275 yard average segment length) x 12 tests per segment = 2,386 tests per week per shift; (54,681 yards per shift per week / 550 yard average segment length) x 12 tests per segment = 1,193 tests per week per shift.

[62] $.06 to $.13 per yard in fabric costs and $.15 per yard in testing costs.

storage and records maintenance. This requirement may double the fabric costs associated with testing.

6.1.3. Living Room and Family Room Furniture

Typically, fully upholstered chairs require about 7 linear yards of fabric, and sofas require 11 to 15 yards, depending on factors such as the need to match patterns (which results in more fabric waste in pattern cutting). Given average estimated increase in fabric costs ranging from $.62 to $1.05 per linear yard for manufacturers, and a typical practice of marking-up manufacturing costs 2.5 times to the retail level,[63] FR treatments of upholstery fabrics under the standard may lead to average retail price increases ranging from $10.85 to $18.38 for chairs and $20.15 to $34.13 for sofas and loveseats.[64] Considering estimates of unit shipments of chairs and sofas (based on an analysis of Department of Commerce data), the average retail price increase per item of furniture requiring changes is estimated to range from $15.76 to $26.68.[65] In addition to costs of FR treatment, the estimated costs of testing range from $.21 to $.28 per linear yard. These costs may lead to average retail price increases ranging from $3.68 to $4.90 for chairs and $6.83 to $9.11 for sofas and loveseats.[66] The average retail price increase per item of furniture related to testing costs is estimated to range from $5.34 to $7.12.[67] The combined average estimated retail price increase resulting from FR treatment of fabrics and testing to assure compliance ranges from about $21.10 to $33.80 per item of furniture.

These costs are expected to apply to most furniture covered with fabrics that are made with cellulosic and thermoplastic fibers, which account for about 75 percent of furniture units sold. Most leather upholstery is expected to pass the small open-flame test without treatments. Most vinyl-coated fabrics also pass without modification. The need for treatments of vinyl-coated fabrics reportedly depends on the polyurethane content of the polymer (for pliability). FR chemicals can be added to the polymer if needed, at a much lower cost than for post-production treatments. Many wool fabrics might also pass a 20-second flame test. However, wool fabrics are not commonly used in furniture upholstery.

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[63] Upholstered Furniture Action Council, "Estimated Costs of the UFAC Program," 1979.

[64] Assuming average fabric yardage for sofas and loveseats is 13 linear yards.

[65] We estimate that in 1997, upholstered living room and family rooms furniture purchased for consumer use was comprised of about 15.6 million sofas, sofabeds, and loveseats (52.7%), and 14.0 million chairs (47.3%). Therefore: ($10.85 x 47.3%) + ($20.15 x 52.7%) = $15.76; and ($18.38 x 47.3%) + ($34.13 x 52.7%) = $26.68.

[66] Assuming average fabric yardage for chairs is 7 linear yard, and average for sofas and loveseats is 13 linear yards. Further, estimated manufacturing cost increases are assumed to be marked up by a factor of 2.5 to the retail level.

[67] We estimate that in 1997, upholstered living room and family rooms furniture purchased for consumer use was comprised of about 15.6 million sofas, sofabeds, and loveseats (52.7%), and 14.0 million chairs (47.3%). Therefore: ($3.68 x 47.3%) + ($6.83 x 52.7%) = $5.34; and ($4.90 x 47.3%) + ($9.11 x 52.7%) = $7.12.

6.1.4. Effects on Retail Prices and Consumer Expenditures for Furniture, and Impacts on Purchasing Decisions

The costs of FR treatments of fabrics (and other increases in manufacturing costs) would be reflected in increased retail prices paid by consumers. The unit price increases (discussed above, by furniture type) may influence purchasing decisions. It is always difficult to determine what consumer reaction will be when both the price and performance characteristics of products change. Consumers may, for example, purchase different styles or fabrics than they would in the absence of any standard-related price increases. Some consumers might be more likely to turn to increased use of credit or they might rent furniture, with or without the option to buy. They may also postpone purchases, by purchasing slipcovers or throws. An estimated 1 to 3 million ready-made slipcovers and an indeterminate number of throws are purchased annually. Custom-made slipcovers may cost as much as $500 to $1,000 each,[68] and a typical sofa reupholstery job may range from $800 to $1,500. Therefore, it is unlikely that many consumers will to turn to custom work in response to price increases resulting from compliance with the standard. To the extent that consumers postpone purchases of new furniture, there would also be a postponement of realization of the benefits of the standard.

In the UK, when prices rose as a result of the imposition of a furniture flammability regulation (which resulted in price increases from changes in urethane foam cushioning in addition to the use of FR treated fabrics), retail demand reportedly was not affected. Promotional activities, such as offering extended payments for furniture purchases, reportedly accompanied the price increases; these are credited with moderating the impact on consumer demand.

6.2. Compliance with the Barrier Alternative

The standard includes a test that would qualify barrier materials as an alternative to the seating area test. Such barriers could be used with fabrics that would not achieve a passing result in the standard's seating area test. A barrier test method was adopted as part of the UK furniture regulations as an alternative for upholstery fabrics that are comprised of more than 75 percent silk or cellulosic fibers. Although the fabrics can burn, the barriers reduce the likelihood that the interior filling components would become involved in combustion. Barriers would thereby reduce the severity of fires that might occur, as suggested by limited CPSC laboratory testing of chairs made with barriers to comply with the UK regulations.[69]

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[68] '97 in Review: shifts in channels, categories., *HFN The Weekly Newspaper for the Home Furnishings Network*, (March 16, 1998), vol. 72, no. 11, p. 24 (2).

[69] Fansler, Linda, Division of Electrical Engineering, Laboratory Sciences, memorandum to Dale Ray, Upholstered Furniture Project Manager, CPSC, "Small Open-flame Tests Using Barrier Fabrics," February 9, 2001.

6.2.1. Barrier Material and Labor Costs

The use of barrier materials to comply with the rule would generally be more costly than FR treatments. Barrier fabrics that comply with the UK regulations' barrier test are FR treated cotton fabric barriers that generally cost furniture manufacturers about 1.5 to 1.85 British Pounds (GBP) per linear meter; one supplier stated that down-proof barriers would cost 2.0 to 2.2 GBP. These fabrics are 54 to 59 inches in width. Converting to dollars (and yards) at current currency rates, this range would be $2.00 to $2.47 per linear yard for standard FR barriers, and about $2.67 to $2.94 per linear yard for down-proof barriers.[70] Materials other than FR treated cotton fabrics also could comply with the barrier test.[71] However, these materials generally are more costly than treated cotton fabric barriers, which the UK experience shows to be the material of choice under its similar provisions.

To the extent that manufacturers already enclose filling materials in interliner fabrics, the FR barriers would be replacing untreated materials. According to industry sources, interliner fabrics are commonly used to encase filling materials in seat cushions, except those found on less expensive furniture. These cushions are usually purchased from fabricators that make them to the specifications of the furniture manufacturers. For seat cushions, the barrier alternative would result in a change in the interior fabric used by the cushion fabricators. For such items, barrier costs would be offset by the costs of the untreated materials, about $.30 per yard for standard interliner fabrics and $.80 per yard for down-proof interliner fabrics.[72] Net increase in material costs would be about $1.70 to $2.17 per yard for standard fabrics and $1.87 to $2.14 per yard for down-proof fabrics. Cushions typically have sides that are about 24 inches long, and they are about 5 inches thick. Therefore, about one linear yard of 54-inch wide interior fabric would be used per seat cushion, and the cost increases per linear yard of material would also hold true for cost increase per cushion.

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[70] In a September 18, 2001, telephone conversation with Charles Smith of the CPSC's Directorate for Economic Analysis, Roger White, President of Clarkson Textiles in the UK stated that the barrier material used in the UK is said to be an FR-treated heavyweight cotton fabric that reportedly costs furniture manufacturers about 1.5 to 1.6 British Pounds per linear meter. In a March 15, 2001, conversation with Charles Smith, Mr. White said that down-proof barriers would be 50 – 60 Pence more per meter than standard barriers. Other inquiries by the CPSC's Directorate for Laboratory Sciences in March 2001 found that barrier fabrics cost 1.5 to 1.85 GBP per linear meter. (Currency exchange rates on September 19, 2001, were $1.46 per GBP.) These prices are consistent with statements by representatives of Dupont and Freudenberg, manufacturers of nonwoven barriers made with aramid fibers, who informed the staff of the CPSC (at an October 30, 2000, public meeting) that barriers that comply with the UK barrier test cost furniture manufacturers about $2.00 per linear yard.

[71] Fansler, Linda, Division of Electrical Engineering, Laboratory Sciences, memorandum to Dale Ray, Upholstered Furniture Project Manager, CPSC, "Alternate Barrier Tests," October 23, 2001.

[72] The price for down and feather-proof ticking, was provided by a Hickory Springs Manufacturing representative during a February 20, 2001 telephone conversation with Charles Smith, directorate for Economic Analysis, CPSC. The price for regular ticking was provided by Cary Kravet, President of Kravet Furniture and Kravet Fabric during a February 23, 2001 telephone conversation with Charles Smith.

Barrier materials required for other parts of the furniture items might require about two yards of material per chair and four yards per sofa. It is likely that these areas are not currently made with interliner fabrics. Therefore, increased material costs probably would be $2.00 to $2.47 per linear yard for standard FR barriers. These materials would increase material costs by about $4 to $5 for chairs and $8 to $10 for sofas. Adding the approximately $2 per cushion material cost increases from substituting the use of FR barriers for standard interliner materials, total increased material costs might be about $6 to $7 for chairs and $14 to $16 for sofas.

In addition to increased material costs, manufacturers would also be faced with additional costs related to labor needed to include FR barriers on parts of the upholstered items that are not currently made with interliner fabrics. The additional labor required might average about 15 to 20 minutes. Hourly labor costs, including benefits, reportedly can be as much as $25 to $30.[73] Therefore, labor costs for the additional upholstery work could be about $6 to $10. Total increases in manufacturing costs (material and labor) are estimated to range from about $12 to $17 for chairs and $20 to $26 for sofas and loveseats. Generally, such manufacturing cost increases would result in increased retail prices of about $30 to $43 for chairs and $50 to $65 for sofas and loveseats.[74] The average increase per item of upholstered furniture that would be made with FR barriers is estimated to range from $41 to $55.[75] Some items that would be made with barrier materials may include markups greater than those typical for furniture production because of the involvement of professional designers and decorators.

The estimated price increases are based on the assumption that barrier materials replace interior fabric currently used on seat cushions. Less expensive furniture items that are currently made without interior seat cushion fabrics would incur greater increases in material and labor costs. The costs of adding barriers to seat cushions could be about $2.00 to $2.47 per cushion for materials, and perhaps $3.50 per cushion for 10 minutes of labor. Compared to barrier costs estimated for furniture currently using interior fabrics on cushions, manufacturing costs could be about $5.50 to $6 higher for chairs and about $16.50 to $18 higher for sofas. The average increase in manufacturing costs per furniture item could be about $11.30 to $12.26 higher than for units currently made with interior fabric on seat cushions.[76] At the retail level, the increase compared to items currently made with interior fabrics on seat cushions could range from about $13.75 to $15 more per chair and $41.25 to $45 more per sofa. This increment at the retail level

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[73] John Bray, Vanguard Furniture, telephone conversation with Charles Smith, Directorate for Economic Analysis, CPSC, February 23, 2001.

[74] Based on a typical markup of manufacturing costs by a factor of 2.5 to the retail level as reported by Upholstered Furniture Action Council, "Estimated Costs of the UFAC Program," 1979.

[75] We estimate that in 1997, upholstered living room and family rooms furniture purchased for consumer use was comprised of about 15.6 million sofas, sofabeds, and loveseats (52.7%), and 14.0 million chairs (47.3%). Therefore: ($30 x 47.3%) + ($50 x 52.7%) = $41; and ($43 x 47.3%) + ($65 x 52.7%) = $55.

[76] (($2.00 material costs + $3.50 labor costs) x 47.3%)) + ($6.00 material costs + $10.50 labor costs) x 52.7%) = $11.30; and (($2.47 material costs + $3.50 labor costs) x 47.3%)) + ($7.41 material costs + $10.50 labor costs) x 52.7%) = $12.26.

could be about $28 to $30 more than the generally more expensive furniture items that currently are made with interior fabrics. Because of the relatively large increase in retail prices that would result from the use of barriers in the more inexpensive furniture products, it is not likely that such items would be made with barrier materials under the standard.

6.2.2. Barrier Testing Costs

Barrier materials used under the standard also will be subject to a sampling plan. Like the sampling plan for upholstery cover fabrics, reduced testing rates are required if successive production runs of barrier materials achieve passing results. We may anticipate that the uniformity of barrier materials will facilitate progressing to reduced sampling rates. Also, average production runs probably would be much longer than those of upholstery cover fabrics; one UK manufacturer of barrier fabric stated that their typical production run of barrier fabric was 10,000 meters.[77] At reduced testing rates under the sampling plan, material and labor costs for testing would be relatively minor, perhaps $.01 per yard of barrier fabric.[78]

6.2.3. Implications of Barrier Alternative

Cost considerations likely will preclude the use of barrier materials for most furniture. However, one of the potential benefits of allowing firms to qualify barrier materials as an alternative to the seating area test is that some fabrics that cannot be successfully treated with FR chemicals (without significant damage to the aesthetic and physical properties) would still be available for use. The Commission received comments indicating that the aesthetic qualities of some FR treated fabrics (*e.g.*, color, softness, drape, and "hand") will be reduced by FR treatments, and, for that reason, would likely be phased out of use as upholstery and lost to the consumer. The use of barrier materials instead of FR treatments for some fabrics could reduce the loss of consumer choice that might result from FR treatment. It would also reduce the economic impact on firms that specialize in fabrics that are more adversely affected by FR treatments. Further, many of the fabrics that would be more difficult to treat without adverse aesthetic effects are expensive decorative fabrics. While the additional costs of barrier materials on furniture covered with such fabrics would be higher than FR treatments, the costs of barriers would be minor in relation to the price paid by the consumer for furniture covered with many of these fabrics.

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[77] Telephone conversation between Charles Smith, Directorate for Economic Analysis, CPSC, and Roger White, President, Clarkson Textiles, Ltd., 2/14/01.

[78] At $2.00 to $2.47 per linear yard, fabric requirements for eight tests would be about 6.7 yards, or $13.40 to $16.55. Labor required might be about .5 hours per test, or $80 for eight tests in a production run under the reduced testing sampling plan. Costs for other materials for eight barrier tests are estimated to be about $12.84 for 51 board feet of polyurethane foam (assuming foam is not reusable), and $24 for Crib 5 ignition sources (assuming they might cost about $3 each). Combined costs of about $130 for testing a production run of 10,000 yards would average about $.01 per yard.

6.3. Compliance with the Dust Cover Test

The draft standard includes testing provisions for dust covers. As noted previously, a vertical flame is applied to a horizontal dust cover specimen for 20 seconds. This is repeated at two other locations. If the dust cover fabric withstands the 20-second exposure without continued combustion (as defined by the test procedures) it would be acceptable for use in the manufacture of furniture. The dust cover test could be done by or for suppliers of the dust cover materials, who could provide certification to the furniture manufacturers regarding the types of materials that comply. Since dust cover materials are uniform, the testing costs would be minimal. Thermoplastic (usually nonwoven) fabrics most commonly used by the furniture industry would meet the standard, since they would melt away from the test flame without continuing combustion when the flame source is removed. Woven fabrics made from blends of cellulosic and thermoplastic fibers (used in a small percentage of furniture pieces) probably could not be used.

A 1995 CPSC survey asked furniture manufacturers that were UFAC Program participants to estimate the percentage of their furniture pieces that had 100 percent thermoplastic (woven or nonwoven) dust covers, cellulosic or cellulosic/thermoplastic blend dust covers, and no dust covers. UFAC participant responses showed that 72 percent of furniture items had thermoplastic dust covers, about 11 percent had cellulosic or blended fabrics as dust covers, and about 17 percent were made without dust covers.[79] The types of products made without dust covers were not reported in the survey data. However, since reclining chairs and convertible furniture such as sofa beds typically are made without dust covers, much of the upholstered furniture made without dust covers probably were such items.

The expected impact of the dust cover requirements would be for manufacturers to substitute nonwoven thermoplastic dust covers for woven fabrics made from cellulosic fibers or blended fibers. Since the prices of thermoplastics are lower than cellulosics, the expected cost impact, if any, is negligible.

6.4. Costs Related to Environmental Controls

The FR treatment of fabrics may increase the amount of wastes generated in the manufacturing process, and the safe disposal of these wastes may increase the costs of production. Workers at fabric finishing facilities may also be exposed to FR chemicals used at the facility.

However, based on testimony of Mr. Les Wilkinson (an official of a UK manufacturer of FR formulations that are sold to backcoating firms) at public hearings held by the CPSC on May 5-6, 1998, the safety precautions for the use of FR chemicals are

[79] Smith, Charles, "Results of Surveys of Manufacturers of Upholstered Furniture," Directorate for Economic Analysis, CPSC, September 1996.

the same as those already in place for similar finishing operations. Moreover, fabric finishers already have experience in handling chemicals safely and in meeting various federal, state, and local regulations regarding environmental and worker safety. Although the standard may increase the number and type of chemicals handled by fabric finishers, FR chemicals are not likely to be more toxic than other chemicals handled by fabric finishers.

An increase in backcoating will generate additional latex waste. However, since 60 percent or more of current production of upholstery fabric is already backcoated for other purposes, the increase might not necessarily require significant new investment in equipment. One contract backcoating firm advised us that waste generated when the backcoating equipment is washed down after a run or shift. The wastes generated are, therefore, more dependent on the frequency of cleaning, rather than on the volume of latex compounds used.

A report prepared for the American Textile Manufacturers Association and other textile organizations concluded that: "estimating the cost of the pollution abatement equipment required under the standard would require a case by case, plant by plant, analysis...."[80] The staff will seek additional information on this impact of the standard.

6.5. Costs Related to Recordkeeping

The proposed standard requires furniture manufacturers to maintain records for a period of three years after items are introduced into commerce. These records shall identify the purchaser, and will specify the fabrics, barrier materials, and dust covers used on furniture items and associated test results, or guaranties of compliance provided by fabric suppliers. Incremental costs related to recordkeeping will depend, in part, on the extent to which furniture manufacturers currently maintain records identifiying upholstery fabrics with finished items. Small firms with limited product lines may require additional labor of less than one man-month a year to maintain the records. Large firms with broad product lines may require the equivalent of an additional full-time employee. Depending on media used to store records, additional office space may also be required. Based on information on clerical wage rates in the furniture industry, recordkeeping costs may generally fall into the range of $1,000 to $15,000 per firm.[81] If these costs average $5,000 per firm, total costs for the industry may be approximately $7.5 million. Average increased costs to manufacturers would be about $.25 per item. If these costs are passed forward to the retail level, aggregate costs may be approximately $19 million annually, or an average of about $.63 per item of furniture.

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[80] Glassman-Oliver Economic Consultants, Inc., "An Economic Analysis of the Draft Small-Open Flame Regulation of Upholstered Furniture," February 2001.

[81] North Carolina Employment Security Commission, "Furniture and Fixtures Hourly Wage," May 2000 release: shows average wages for most-numerous clerical positions ranging from $9.25 to $11.28.

6.6. Other Costs

Other costs of the draft standard might include those related to changes in business operating practices of fabric distributors, costs related to effects of product changes on aesthetic characteristics of furniture, and potential adverse health effects. Many of these impacts on industry and consumers cannot be easily monetized or quantified.

6.6.1. Fabric Distributors

A mandatory standard may reduce the demand for certain types of fabrics, and could, therefore, affect some fabric distributors. The impacts on individual firms would depend on the types of fabrics they stock and the proportion of their revenues from sales to the furniture industry. Some fabrics may be diverted for purposes other than furniture upholstery, such as window treatments. If such fabrics continue to be available without FR treatments these firms would have to increase their number of Stock Keeping Units (SKU's) to satisfy their customers' needs for both forms of the fabrics. The standard could result in increased recordkeeping for the affected fabric distributors, ordering in smaller quantities, reducing the number of styles offered, and increasing space devoted to fabric stocks.

6.6.2. Costs of Changing and Maintaining Fabric Samples

Books containing samples of fabrics are commonly found at furniture and fabric retailers. The Commission has received comments that fabric manufacturers and wholesalers would have to revise books so that consumers could see and feel samples of FR treated fabrics. Commenters also state that, since treated and untreated versions of fabrics will be available to consumers, the standard will result in a doubling of resources devoted to the maintenance of samples, including those offered in sample books.

For firms that specialize in the production and marketing of decorative fabics, much of the impact on the maintenance of sample books and other fabric samples will be moderated by the provision of the standard that allows the use of barrier materials. Many of these fabrics will continue to be used without FR treatments, and there would be no impacts on the costs of maintaining samples. Many other fabrics may only be shown in sample form in their treated state. There would be initial costs incurred to offer treated fabric samples. Thereafter, annual costs to maintain treated samples would be related to the costs of applying FR treatments.

6.6.3. Aesthetic and Physical Characteristics of Fabrics

In the UK, initial fabric treatments reportedly resulted in poor aesthetic qualities and physical characteristics of fabrics (such as altered colors, poor drapability, handling, and breathability of the fabrics, and decreased fabric tear-strength and abrasion

resistance). According to officials of British government, textile, FR chemical, and furniture manufacturing organizations, these initial problems have largely been overcome. For instance, backcoating treatments now are applied in much thinner applications that do not detract from most fabrics to which they are applied. FR chemicals applied to fabrics without backcoating when the match test was first required were applied in loadings similar to those used for fire-resistant clothing; this was more than necessary, and the fabrics' abrasion performance and tear-strength were adversely affected. According to an official with the testing facility associated with the largest upholstered furniture manufacturer in the UK, these problems have also been resolved, although some fabric manufacturers we contacted claim that reduced abrasion resistance remains a problem. Also, although FR chemicals applied without backcoating can affect the colors of fabrics, BITA reports that chemical manufacturers now advise fabric producers on adjustments they can make in order to achieve the desired colors after treatment.

Despite advances that have been made in FR treatment, some types of upholstery fabric present greater difficulties than others regarding successful treatment for flame resistance with acceptable aesthetic and physical properties. The loss of fabric types to the furniture market would be lessened by future advances in treatment methods. More immediate regulatory relief is designed into the rule by the optional use of barrier materials. Many of the fabrics that are more severely affected aesthetically by current FR treatments probably will be used over such barriers under the standard.

7. COSTS AND BENEFITS

7.1. Costs and Benefits of FR Treatments of Upholstery Fabrics

As discussed earlier, the projected benefits associated with preventing furniture fires started by small open flames and cigarettes are about $40.88 to $59.32 per item (based on the "best estimates" and lower bounds of the 95 percent confidence intervals of estimated reductions in ignition propensities), over its useful product life. About 80 percent of the projected benefits are derived from preventing fires started by cigarettes.

The average estimated costs to consumers from improved small open-flame ignition resistance of living room and family room furniture is about $15.76 to $26.68 per item for FR treatment of fabrics. Adding an additional $5.34 to $7.12 for testing and $.63 per unit related to recordkeeping costs yields total per unit costs at the retail level of $21.73 ($15.76 + $5.34 + $.63) to $34.43 ($26.68 + $7.12 + $.63). Thus, the projected net benefits of the proposed standard for these items range from about $6.45 ($40.88 - $34.43) to about $37.59 ($59.32 - $21.73) per unit of complying furniture produced. [82]

[82] The range of net benefits was derived by subtracting the high end of estimated costs from the lower bounds of estimated benefits, and subtracting the low end of estimated costs from the "best estimate" of estimated benefits.

7.2. Costs and Benefits of Using Barrier Materials

If manufacturers choose to comply with the standard by using inert barriers, these should prevent the involvement of filling materials in combustion. However, the use of a barrier would still allow the upholstery fabric to ignite from a small open flame. Also, a cigarette might be expected to char cellulosic fabrics used with barriers. Limited testing data indicate that barriers would effectively reduce fire growth. Barriers could also result in a reduction in fire growth if ignition sources other than small open flames or cigarettes are involved, or in scenarios in which furniture is not the first item ignited.

The extent to which barriers will reduce deaths, injuries, and property damage is uncertain. For the purposes of this analysis we assume that the use of barriers would lead to reductions in fire losses from ignitions of upholstered furniture that are roughly equivalent to benefits from FR treatment of upholstery fabrics. Therefore, as in Section 7.1. above, combined projected benefits of reducing fires started from both small open flames and cigarette ignition sources over the useful product life of furniture range from about $40.88 to $59.32 per unit affected.

The average estimated costs to consumers from the use of FR barriers is about $41 to $55 per item of furniture. Adding estimated per unit costs (at the retail level) associated with recordkeeping of $.63 per unit yields total estimated costs to consumers of $41.63 to $55.63 per unit. Thus, the projected net costs or benefits of the proposed standard for these items range from net costs of about $14.75 ($40.88 - $55.63) to net benefits of about $17.69 ($59.32 - $41.63) per unit of complying furniture produced with barrier materials.

7.3. Aggregate Costs and Benefits

Aggregate estimates of the benefits and costs of the standard can be projected over the production cycle, based on an estimated annual production of 30 million units of upholstered living room and family room furniture. Assuming fabrics of about 75 percent of the upholstered furniture would undergo FR treatment or would be used with FR barriers, the expected gross benefits over the useful product lives of the furniture produced in a year may be projected. The gross benefits are estimated to range from about $920 million (30 million units x .75 x $40.88) and $1,330 million (30 million units x .75 x $59.32), respectively.

Aggregate costs to consumers associated with a standard affecting living room and family room furniture would depend on the percentage of items that are made with FR treated fabrics vs. FR barriers. The use of barriers is more economically feasible with more expensive fabrics, such as those produced by members of the Decorative Fabrics Association (DFA). The DFA estimates that fabrics marketed by its members comprise

perhaps 1.5 percent of total upholstery fabric yardage used to make furniture.[83] It may be reasonable to assume that other fabrics would also be used with barriers. If 5 percent of furniture items undergoing changes to meet the standard are made with FR barriers, estimated aggregate costs range from $515 million to $802 million.[84]

Thus, net benefits from the standard related to living room and family room furniture would be expected to range from $118 million (projected gross benefits of $920 million - estimated costs of $802 million) to about $815 million (projected gross benefits of $1.33 billion - estimated costs of $515 million).

This analysis assumes that manufacturers will use FR treatments in a manner that poses no additional risk of injury or adverse health effects to consumers.

8. ALTERNATIVES TO THE PROPOSED RULE

8.1. Alternatives Modifying the Draft Standard for Small Open-Flame Ignition Resistance

The proposed standard has a number of features that could be adjusted or modified to alter their potential economic effects. These alternatives include expanding the scope of product coverage, proposing additional or alternative testing requirements, labeling requirements, and changing the effective date. Labeling, by itself, in lieu of a standard, could also be an option.

8.1.1. Alternative Scope

Specific products that could be included under alternative definitions of the scope of the rule are discussed below:

8.1.1.1. Upholstered Dining Chairs

The Commission could include dining chairs with contiguous upholstered seats and backs from the scope of the standard. Annual production of perhaps 2 to 4 million dining chairs with upholstered seats and backs might be subject to the proposed standard.[85] About two linear yards of fabric are typically used to make dining chairs with upholstered seats and backs. At an average increase in costs to furniture

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[83] Information provided to the staff at a June 29, 2000, public meeting.

[84] Comprised of average retail price increases for items using FR treated fabrics: [(30 million units x .749 x .95 x ($21.73 to $34.43)] plus increases for items using barriers: [(30 million units x .749 x .05 x ($41.63 to $55.63)] plus retail price increases related to recordkeeping costs for items that will not require modifications: (30 million units x .251 x $.63).

[85] See discussion in section 3.1.4. for derivation of numbers of dining chairs affected. Upholstered dining chairs without upholstered backs, or with upholstered seats and backs that are not contiguous, are not within the scope of the proposed standard.

manufacturers of $.62 to $1.05 per linear yard for FR treatment, $.21 to $.28 per linear yard in testing costs, and $.25 per item in recordkeeping costs, total manufacturing cost increases for dining chairs would range from $1.91 to $2.91 per chair covered with fabric that would require FR treatment. These manufacturing cost increases could result in average retail price increases of $4.78 to $7.28 per chair using FR treated fabric.[86]

Data on upholstery fabrics used in this market segment are not available. Assuming that about 80 percent of fabrics used in the manufacture of dining chairs would require FR treatments, total fabric consumption for chairs within the scope of the standard that would require FR treatments might be on the order of 3 to 6 million yards. Aggregate increases in retail outlays could total about $8 - 24 million.[87]

There is no information indicating that dining chairs have been the initial item ignited in any of the fires. A 1997 CPSC special study of upholstered furniture fires associated with small open-flame sources found that only 12 of 76 investigated fires (16%) involved **chairs of any type**, including living room chairs, recliners, and rocking chairs; 63 involved sofas or sofa beds.[88] Seventy additional In-Depth Investigations (IDI's) have been conducted since the 1997 special study. Combining the two sets of IDI's, about 19 percent of the cases for which the type of furniture was determined involved chairs of any type. Since shipment data show that the number of all types of upholstered chairs in use exceeds the number of sofas and sofa beds, chairs, including dining chairs, appear to be much less likely to be involved in fires. Moreover, none of the IDI's of fires involving upholstered chairs contained any information that would indicate that a dining chair was the item ignited. It is likely that the generally smaller fuel loadings of dining chairs (*e.g.*, available combustible mass of fabrics and filling materials) present less dangerous fire conditions than other types of upholstered chairs, when ignition does occur.

Thus, while the costs of the proposed standard might add about $5 to $7 to the prices of dining chairs, there is no evidence that the benefit of including these items within the standard would offset the costs.

8.1.1.2. Home Office Furniture

The Commission could include upholstered home office furniture, such as desk chairs with contiguous upholstered seats and backs, from the scope of the standard. Fabric requirements for desk chairs are much smaller than for other upholstered furniture, perhaps 1.5 linear yards, on average. At an average increase in costs to furniture manufacturers ranging from $.62 to $1.05 per linear yard, $.21 to $.28 per linear

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[86] Assuming a markup factor of 2.5 for manufacturing costs to the retail level.

[87] 2 – 4 million chairs x 2 linear yards per chair x 80% of total yardage requiring treatment = 3.2 to 6.4 million linear yards requiring treatment. At ($.62 + $.21) to ($1.05 + $.28) per yard and $.25 per item in recordkeeping costs, estimated manufacturing costs total $3.2 - $9.5 million. With a 2.5 markup factor, total estimated increases in retail outlays = $8 - $23.8 million.

[88] Long (Ault), Kimberly, "Final Report on Small Open Flame Upholstered Furniture Fires," Directorate for Epidemiology, U.S. Consumer Product Safety Commission, September 16, 1997.

yard in testing costs, and $.25 per item in recordkeeping costs, total manufacturing cost increases for desk chairs would range from $1.50 to $2.25 per chair covered with fabric that would require FR treatment. These manufacturing cost increases could result in average retail price increases of about $3.75 to $5.63 per chair using FR treated fabric.

Estimated annual sales of upholstered office furniture to the residential market are about 4 to 5 million units. The percentage of these items covered with leather and vinyl may be higher than for other household upholstered furniture, perhaps 30 to 40 percent. Therefore, 2.4 to 3.5 million chairs might require modifications in order to comply with the standard. Perhaps 3.6 to 5.3 million linear yards of fabric may require FR treatments in order to be used on furniture bound for household use. Costs to the furniture industry might be about $3.6 - $7.9 million annually. These costs might result in increased consumer outlays totaling about $9 - 20 million annually.

Like dining chairs, the generally lower fuel loadings for desk chairs probably present lower risks than other furniture falling within the scope of the standard. Moreover, none of the IDI's provided any indication that home office furniture was involved in fires. Consequently, there is no evidence the benefits of including home office furniture within the scope of the standard would offset the costs.

8.2. Labeling

The draft proposed standard does not contain labeling provisions. A rule requiring hazard information to be presented on labels could be adopted by the Commission in lieu of a standard. The costs of labeling would be just a few cents per item (based on reported labeling costs under the UFAC Voluntary Action Program and estimates provided by a manufacturer). However, the impacts of such labeling on consumer behavior and product safety may be minimal. As noted by the CPSC's Division of Human Factors, for a warning label to have any chance of improving the safety of a product, it must be aimed towards those people whose behavior needs to be changed.[89] The small open-flame hazards are largely attributable to children playing with lighters and matches, who are unlikely to read, or be affected by, the statements provided. Informing consumers at the time of purchase that the item complies with a performance standard would have minimal impacts on safety if nearly all household upholstered furniture were in compliance.

8.3. Effective Date

Section 4 of the Flammable Fabrics Act states that standards or regulations under it shall become effective twelve months from the date of promulgation, unless the Commission finds that a different effective date is in the public interest. Because of the

[89] Timothy P. Smith, ESHF, CPSC, memorandum to Dale R. Ray, Human Factors Response to Upholstered Furniture ANPR Comments," April 3, 1997.

need for FR treatment of most fabrics used in the manufacture of furniture and the fact that furniture manufacturers carry stocks of fabrics, a longer period before the rule becomes effective, 18 months, would reduce industry disruption, especially among upholstered furniture manufacturers with large fabric inventories.

The announcement of the UK upholstered furniture flammability regulations was made in June 1988, with an effective date for the new requirements of March 1990, about 20 months later. The requirements applied to furniture sold to consumers after the effective date. This reportedly caused significant short-term disruption of the British furniture and fabric industries, which had relatively little experience with fabric backcoating. The capacity of the fabric industry reportedly was inadequate to meet such a short effective date.

The U.S. textile industry is in a better position than their UK counterparts were to provide fabrics that would meet similar requirements for small open-flame ignition resistance. U.S. firms reportedly have used backcoating more extensively than UK fabric producers for reasons other than to provide fire retardance. Experience gained in complying with the UK regulations by FR chemical suppliers, fabric mills and finishers, and furniture producers will benefit U.S. firms; in fact, many of the major U.S. upholstery fabric manufacturers are supplying complying fabrics to the UK.

Furniture manufacturers generally introduce new fabrics and styles twice each year; for many, these introductions coincide with the Spring and Fall Furniture Markets at High Point, NC. Manufacturers may stock a few hundred to more than 1,000 fabric patterns, each in perhaps 3 to 5 colors. Although fabrics are constantly introduced and dropped from product lines of furniture manufacturers, some fabrics might be kept for a few years even though they are not being used.

Several options might be available to furniture manufacturers that have fabric that does not comply with a regulatory alternative adopted by the CPSC as the effective date for the action approaches. They might send the remaining fabric yardage to contract finishers for backcoating with FR chemicals. They could use FR barrier materials beneath the untreated fabric, as allowed by that alternative method of compliance with the standard. Also, they might sell the fabric to jobbers who would market it to furniture manufacturers that use FR barriers with untreated upholstery fabrics and for other end-uses that are not within the scope of the regulation. They could use it for furniture exported to another country (subject to notification requirements under the FFA). It is conceivable that they could still use the fabric in furniture locations that are not subject to the regulation, such as outside backs and sides (matched with fabrics identical in appearance that have been FR-treated); however, this option would have a products-liability disincentive. Despite the presence of these options, an effective date that is twelve months from the date of promulgation would be much more burdensome to furniture manufacturers than one that is 18 months.

Adopting an even longer period before the standard becomes effective, for example, 24 months, rather than 18 months, would provide the affected industries with additional time to adapt their production to the new requirements. Furniture manufacturers would be afforded additional time to use stocks of untreated fabrics that do not comply with the standard's testing provisions and fabric manufacturers and finishers might develop more effective and efficient processes to comply with the standard. The beneficial effects of this alternative for the affected industries would be offset by the additional delay in the availability of complying furniture to consumers.

8.4. No Action

The Commission could determine that no rule is reasonably necessary to reduce the risk of fires associated with small open-flame ignitions of upholstered furniture. Under this alternative, future societal losses would be determined by factors that affect the likelihood that ignition sources come in contact with upholstery and the ignition resistance of upholstery materials used by furniture manufacturers. Since the standard would also be expected to reduce cigarette ignitions, those losses would also be expected to continue if no action is taken. Future cigarette ignition losses would also be determined by the ignition resistance of materials used to manufacture furniture (mainly shifts in usage of predominantly cellulosic fabrics). Factors other than furniture materials will also determine cigarette ignition fire losses in the future. Some of these will tend to increase future losses (such as projected annual increases of about 1 percent in population and households) and others might decrease future losses (such as continued reductions in rates of smoking and alcohol consumption, changes in the burning characteristics of cigarettes, increasing smoke alarm operability, information and education efforts, and installation of sprinkler systems in new construction).

United States
CONSUMER PRODUCT SAFETY COMMISSION
Washington, D.C. 20207

MEMORANDUM

DATE: October 23, 2001

TO : Dale R. Ray, Upholstered Furniture Project Manager

Through: Warren J. Prunella, AED, Economics

FROM : Charles Smith, Economics

SUBJECT: Upholstered Furniture Flammability: Analysis of Comments

The U.S. Consumer Product Safety Commission (CPSC) is considering a staff options package that addresses the ignitability of upholstered furniture when exposed to small open flame sources such as matches, lighters, and candles. The principal option under consideration is the adoption of a draft mandatory standard. If that standard were to be adopted, it is likely that most upholstery fabrics would be treated with flame retardant (FR) chemicals. The CPSC held public hearings on May 5-6, 1998, and solicited public comments on issues ranging from potential toxicity of FR chemicals to possible economic impacts.

This memorandum discusses economic issues raised by individuals and organizations that submitted comments regarding the prospective use of FR chemicals as a means to comply with a small open flame flammability standard. The comments received during the period specified by the CPSC's solicitation are addressed first. In February 2001 the CPSC also received two reports on economic issues that were prepared under contract to industry groups. The issues raised by these reports are considered separately, along with information submitted after the comment period by the Decorative Fabrics Association (DFA) in support of their contention that decorative fabrics sold through professional decorators should be exempt from the standard.

A. Issues Raised During the Comment Period Specified by the Commission

Comment: *The Office of the Chief Counsel for Advocacy of the U.S. Small Business Administration (SBA) (#4) comments that the CPSC must demonstrate the need for a regulation: convincing data must be provided showing the standard's effectiveness at reducing fires; relevant cost data must be considered and the impact on small businesses determined; and less burdensome alternatives must be considered. The office also*

comments that there is inadequate explanation of the fire data, such as the extent to which fires involve arson, childplay, candles, and other factors.

Response: The staff agrees that the CPSC must demonstrate the need for the regulation. This includes providing sufficient data to show the regulation's effectiveness at reducing fires, discussing regulatory alternatives, describing the impacts of the regulation on small businesses, and providing an explanation of the fire data. Most of these issues are addressed in the Options Package. All of these issues would be addressed in detail in a Briefing Package should the Commission propose a rule.

Comment: *The Office of the Chief Counsel for Advocacy of the U.S. Small Business Administration (SBA) (#4) comments that a substantial number, if not the vast majority, of the firms affected by the [draft] standard are small businesses under SBA definitions. Therefore, an Initial Regulatory Flexibility Analysis is required under the Regulatory Flexibility Act. The commenter states that the CPSC must consider flexible regulatory alternatives that reduce the burden on small businesses while still allowing the agency to accomplish its regulatory and public policy objectives.*

Response: Most of the firms that would be affected by the standard, if proposed as a mandatory rule, are small businesses. If the Commission directs the staff to proceed, an Initial Regulatory Flexibility Analysis that discusses regulatory options that could reduce the burden of the rule for small businesses will be prepared.

Comment: *The Coalition of Converters of Decorative Fabrics (CCDF) (#17) comments that its members would have to assume the additional cost of retaining third party finishers to treat fabrics. They state that few companies exist that could provide the treatment services, and these facilities would be overtaxed under a mandatory standard. Therefore, CCDF comments that treatment costs are likely to escalate. (A similar comment was filed by the Decorative Fabrics Association (DFA) (#18)*

Response: Based on information provided by major fabric and furniture manufacturers we contacted, 60 percent or more of upholstery fabric yardage used in furniture production currently is backcoated for reasons other than to impart flame retardance. Fabric finishers in the UK and U.S. that backcoat fabrics with FR chemicals also informed us that the equipment already used to backcoat for non-FR purposes is used for application of FR backcoatings. Therefore, while it is possible that treatment facilities may be heavily utilized in the short run, there is no reason to believe that the treatment costs are likely to escalate substantially.

With respect to the specific impacts of the standard on members of the CCDF, it is possible that many of the fabrics marketed by these firms will be used over barriers that comply with the draft standard's barrier test. It would not be necessary for such fabrics to be FR-treated.

Comment: *Everfast, Inc., an operator and franchiser of fabric and home furnishings stores, (#16) commented that the impact of the rule on fabric costs would substantially reduce the demand for decorative fabrics, with corresponding store closings and loss of*

jobs. Everfast states that its primary line of business is the sale of decorative fabrics by the yard to retail customers; further, it is one of the biggest customers of the major manufacturers of decorative fabrics.

Response: The retail upholstery fabric purchases (such as those at stores operated by Everfast) that are used to reupholster furniture items for use by the purchaser of the fabric are not within the scope of the draft standard. Also, other suitable uses for many of these fabrics (such as for window treatments) are not subject to the standard. Purchased fabrics that are provided to furniture manufacturers to be used in the manufacture of a new item of furniture would be subject to the standard. However, exclusion of other end-uses should result in minor impacts on the operations of decorative fabric retailers.

Comment: *Everfast, Inc. (#16) comments that fabric manufacturers would be forced to choose to either: a. Treat all fabrics at the time of production as if the end-use were furniture; or b. Custom treat small yardages after the fabric has been selected to cover furniture. Everfast states that this could increase costs by as much as 50% and would add 2-3 weeks to the time required to deliver fabric.*

Response: Fabric manufacturers currently perform several different types of finishing operations depending on the intended use or customer specifications. Further, significant non-furniture markets will remain for fabrics that would not have to comply with the standard. Therefore, we would not expect all fabrics that might be suitable for use as upholstery to be treated with FR chemicals. Available information indicates that FR treatments generally would add $1.05 or less per yard to furniture manufacturers' cost of upholstery fabric. This would be well under the 50 percent estimate of Everfast. Small yardages of fabric sent to contract finishers could be subject to minimum charges, which could increase costs per yard. However, this should not apply to the vast majority of fabrics that would be treated to comply with the standard. Additional time required to have FR treatments applied would depend on several factors, including whether the fabrics would have received backcoating for purposes other than flame retardance. An official with a U.S. fabric finisher advised us that fabrics that are received for backcoating are in their possession for an average of 7-10 working days. The period varies because they have to wait until they have enough yardage of similar weight and color to do a backcoating run. However, he also said that if the volume of FR backcoating increased significantly (*e.g.*, because of a standard) the period would likely be shorter: perhaps 2 to 3 days since it is likely that they would be dealing with full rolls of fabric.[1]

Comment: *The Coalition of Converters of Decorative Fabrics (CCDF) (#17) and the Decorative Fabrics Association (DFA)(#18) commented that their members would have to maintain multiple inventories of decorative fabrics: treated fabrics for upholstery, and untreated fabrics for other uses, such as draperies. This would result in redundant warehouse and production costs, software reprogramming costs, complications in the purchasing process for customers, and delays in delivery time of the finished product to the ultimate consumer.*

[1] Telephone conversation between Charles Smith, Directorate for Economic Analysis, CPSC, and Tom Applegate, Resistflame Finishing Co., November 21, 2000.

Response: Some fabric treatments may result in fabrics that are not suitable for draperies and other non-furniture uses. We agree that it is likely that fabric inventories of some firms would be expanded to include treated and untreated fabrics. This impact is likely to be minimized by the alternative available to furniture manufacturers that allows them to use untreated fabrics over barrier materials.

Comment: *The DFA also commented that they would incur considerable costs to maintain "sample books" with both treated and untreated fabrics; which they believe would be necessary because of the different feel of the two types of fabrics.*

Response: The need to maintain treated and untreated fabric samples probably would depend on the differences in stiffness and other fabric characteristics that result from treatment. Some treated fabrics are barely distinguishable from untreated fabrics. However, to the extent that fabric dealers consider it necessary to have treated and untreated samples, associated costs would increase. Many producers of decorative fabrics may choose to market only untreated fabrics for use in furniture made with acceptable barrier materials, thereby reducing the need to offer both treated and untreated fabric samples.

Comment: *Several comments were received related to the issue of the effects of FR chemical treatments on aesthetic characteristics of fabrics, and the resulting impacts on the availability of fabrics (consumer choice) and on the businesses that manufacture and use such fabrics. The American Textile Manufacturers Institute (ATMI) (#22) commented that many fabric constructions will be lost to the consumer because their pleasing aesthetic qualities (e.g., color, softness, drape, hand) will be ruined when treated. The Coalition of Converters of Decorative Fabrics (CCDF) (#17) comments that products printed, woven or otherwise produced through specialized processes unique to a foreign country might not be able to maintain their structural or textural integrity if they are subsequently treated with FR chemicals. They state that these fabrics would no longer be available for sale [as upholstery for furniture] in this country. Cathy Jones, a member of The American Society of Interior Designers (ASID), also stated her belief that the added stiffness and diminished aesthetic appeal of upholstered furniture made with FR treated fabrics would cause consumers to summarily reject those products. Further, she commented that this would add to economic losses of the furniture industry, retailers, distributors, and interior designers.*

Response: We recognize that some types of upholstery fabric present greater difficulties than others regarding successful treatment for flame resistance with acceptable aesthetic and physical properties. However, the experience with a similar small open flame testing requirement in the UK indicates that the impact may not be as severe as claimed by some commenters. An official with the major testing facility in the UK (which is also a division of a major UK furniture manufacturer) stated that fabrics such as double-cloth pocket fabrics and chenilles are successfully backcoated and used in the UK. However, he did say that some lightweight fabrics at the very high end of the market cannot be backcoated successfully; neither can silk fabrics.

Despite the reported success in maintaining a wide variety of fabrics that have been treated with FR chemicals in the UK, we concur that FR treated versions of some fabrics might not have acceptable aesthetic characteristics for use under the standard. Future advances in treatment methods or successful applications of intumescent laminates may enable more fabrics to comply with the standard's seating area test. Additionally, fabrics that are determined to have unacceptable aesthetic characteristics following FR treatments may continue to be used over barrier materials.

Comment: *Other comments were received regarding the inability to treat certain types of fabrics so that they would comply with the standard. The National Cotton Council (NCC) (#25) commented that lightweight cotton and silk cannot be backcoated; technology for FR treatments of cotton/polyester blends is not available (unless one of the fibers is less than about 10-15%); and lightweight cotton and synthetic fabrics may not be able to prevent involvement of filling materials after a 20 second flame. The Decorative Fabrics Association (DFA) (#18) also commented that some fabrics cannot be treated successfully, which would result in a loss of consumer choice.*

Response: Although these comments were more directed at technical feasibility, the issue of adverse aesthetic effects of FR treatment discussed above probably cannot be completely separated. As stated above, we recognize that some types of upholstery fabric present greater difficulties than others regarding successful treatment for flame resistance. Future advances in treatment methods or successful applications of intumescent laminates would allow fabrics that are more difficult to treat successfully to comply with the standard's seating area test. Also, untreated fabrics may be used over barriers.

Comment: *The American Society of Interior Designers (ASID) (#13) commented that consumers would reject FR treated products due to increased stiffness and lower aesthetic appeal. ASID further commented that consumers would cover furniture upholstered with FR treated fabrics with more comfortable, appealing and potentially more flammable textiles found in the home.*

Response: As noted above, experience in the UK indicates that severe adverse aesthetic effects may be limited to relatively few fabric types. Further, although FR treatments might result in adverse aesthetic effects for some types of fabrics, there is no basis to assert that this would result in significant numbers of consumers covering upholstered items with other, more ignition-prone textile products.

Comment: *ATMI (#22) commented that a fabric manufacturer visited by the CPSC staff would have to add a backcoating line to treat its fabrics. However, state EPA restrictions on commercial water use would lead to a denial of the firm's application to perform this function, and it would have to use outside fabric finishers to treat its fabrics.*

Response: It has been a common practice for fabric manufacturers or purchasers of fabric to rely on independent firms for fabric finishing operations. In fact, this function has had its own industry designation by the Bureau of the Census. Fabric finishers are classified in NAICS code 313311, which incorporated SIC 2261 ("Finishing Plants,

Cotton") and SIC 2262 ("Finishing Plants, Synthetics"). Therefore, there will not be a need for all fabric manufacturers to have their own backcoating operations, although some may choose to do so. Local restrictions on waste controls and disposal would be one of the considerations in determining whether backcoating or other treatments would be done on-site.

Comment: *The Coalition of Converters of Decorative Fabrics (CCDF) (#17) comments that exports of its members could be significantly curtailed, since certain countries do not permit chemically treated fabrics to be sold.*

Response: The draft standard does not require that exports be chemically treated. Additionally, this comment is at odds with the statement that CCDF members would carry dual inventories of treated and untreated fabrics. If they do carry treated and untreated fabrics, they would be free to export the untreated fabrics if they so choose.

Comment: *The DFA (#18) commented that treated fabrics are likely to exhibit numerous negative characteristics, including color bleeding, dimensional changes, reduction in strength and durability, and textural irregularities. As a result, they comment that the expected life span of furniture would decrease.*

Response: Although FR treatments may result in some negative effects on aesthetic characteristics for some fabrics, product durability has not been found to be an issue in the UK, according to furniture industry officials with whom we have consulted.

Comment: *American Flamecoat of Southern New Jersey (#28) commented that the flame retardants on the market today do not cause stiffness or change the color of the fabric. A similar comment was filed by International Fire Control Systems, Inc. (#29).*

Response: These comments relate to FR chemicals that reportedly are topically applied to fabrics. We are not sure whether these specific chemical treatments would be used under the standard. Information on other types of chemical applications indicates that increased stiffness, color change, and other adverse aesthetic effects can result for some fabrics.

Comment: *The Upholstered Furniture Action Council (UFAC)(#20) commented that non-FR backcoatings, such as those done to provide dimensional stability for fabrics, are subjected to various forces that tend to degrade them over time. They cited anonymous firms in the UK who informed them that FR backcoatings could also break down. UFAC comments that the breakdown of FR backcoatings would reduce their effectiveness in reducing the fire hazard.*

Response: To the extent that FR backcoatings "break down," the effectiveness of the treatments would be reduced over time. Testing conducted by CPSC Laboratory staff found no effects on flammability of FR treated fabrics that were subjected to cleaning and simulated wear. The lack of specific information about the nature of, and extent of, the degradation that might occur does not lead us to adjust our estimates of effectiveness.

Comment: *UFAC (#20) commented that many factors make it difficult to apply FR backcoatings consistently.*

Response: We trust that U.S. firms will work to overcome difficulties in applying backcoatings uniformly. Fabrics that will be certified as complying with the standard by virtue of sample test results would still result in a reduction of the ignition propensity compared to untreated fabrics, even if backcoatings are not uniform. The regulatory analysis does not assume that fabrics that are certified as being in compliance will completely eliminate the small open flame ignition hazard.

Comment: *UFAC (#20) commented that there is virtually no one in the U.S. who is FR backcoating for use in the U.S.*

Response: Because of limited demand, there are relatively few firms that currently FR backcoat fabrics. However, UK and U.S. backcoaters advise us that the equipment used to backcoat fabrics for non-FR purposes, which is a common practice in the U.S., can be used for FR-treatments applied as backcoats. Therefore, expertise in backcoating for the purpose of FR treatment, and availability of equipment, may not be a significant issue.

Comment: *ATMI (#22) commented that the "Economic Considerations" paper omitted a number of costs from its discussion. Specifically, ATMI commented that the industry would be required to purchase new equipment to treat fabrics. The majority of upholstery fabric manufacturers reportedly do not post-treat fabrics after the goods are woven. New lines would have to be installed for treating fabrics. The current U.S. capacity would not meet the demands of the regulation and there would be long delays to obtain goods.*

Response: As noted previously, information provided by major fabric and furniture manufacturers indicates that a high percentage of upholstery fabrics are backcoated for reasons other that flame retardance. Also, UK and U.S. backcoaters informed us that the equipment used for non-FR backcoating is also used to apply FR treatments. Therefore, although it would be reasonable to expect that some firms would install additional equipment to meet the increased demand for backcoating, the initial undercapacity may not be severe. Further, costs are based on charges currently imposed by fabric finishers; these charges presumably consider amortized costs of the necessary capital equipment. Therefore, capital equipment costs are implicit in the total estimated costs of the draft standard.

Comment: *ATMI (#22) comments that compliance with environmental, safety and health regulations will have a "phenomenal monetary impact on the industry." ATMI also cited one of its member company's estimates that the regulation would significantly increase the quantity of pollutant generated in waste during the manufacturing process. This firm reportedly would incur significant costs to dispose of hazardous wastes that could not be discharged into wastewater (as is now the case with current levels of pollutants).*

Response: Fabric finishing operations, whether done at facilities at the fabric manufacturer or at outside finishers, add backcoatings, soil release agents, and other fabric treatments. Most upholstery fabric is already processed in some way. The standard may increase the amount of wastes generated, and the safe disposal of these wastes may increase the costs to some finishers.

Workers at fabric finishing facilities may be exposed to FR chemicals used at the facility. Based on testimony of Mr. Les Wilkinson (an official of a UK manufacturer of FR formulations that are sold to backcoating firms) at the Public Hearing, the safety precautions for the use of FR chemicals are the same as those already in place for similar finishing operations. Moreover, as noted in the Preliminary Environmental Review, fabric finishers already have experience in handling chemicals safely and in meeting various federal, state, and local regulations regarding environmental and worker safety.

Comment: *ATMI (#22) comments that a recently published study by Keyser Ciprus Ltd., indicates a substantial difference in the consumption of residential upholstery fabrics from the number quoted in the October 1997 CPSC briefing package: residential upholstery fabrics - used on motion, recliners, sofa sleepers, stationary upholstery, and occasional chairs - increased from 402 million linear yards in 1993 to 403.3 million linear yards in 1997. This converts to about 605 million square yards. The Directorate for Economic Analysis previously estimated that annual consumption of upholstery fabrics for the production of upholstered furniture was in the range of 290 to 340 million square yards.*

Response: Reliance on estimates of U.S. consumption of residential upholstery fabrics based on fabric production overstates the potential impact of the standard because there are other markets for these fabrics that will not be subject to the standard. Furthermore, a large percentage (perhaps 20 percent) of upholstery fabric production by U.S. firms is exported.

The Keyser Ciprus report cited by ATMI also presented findings from its survey of 70 residential upholstered furniture manufacturers, which it estimated to account for 70 percent of total consumption of upholstery fabric used in the production of residential upholstered furniture. Keyser Ciprus reported that the surveyed firms consumed 166,649,250 lineal yards of upholstery fabric in 1997. If Keyser Ciprus was correct in estimating that surveyed firms accounted for 70 percent of total fabric yardage consumed, total yardage used in the manufacture of residential upholstered furniture would have been about 238 million linear yards. This total does not include leather and vinyl upholstery, which we estimate to have comprised about 25 percent of all furniture upholstery materials used in 1997. Therefore, total upholstery use for the domestic manufacture of residential upholstered furniture was about 317 million linear yards.

Another method of estimating consumption of upholstery fabric in the manufacture of furniture is to consider information on average requirements for chairs and sofas and multiply that by total unit shipments. According to industry sources, an average of approximately 7 linear yards of fabric is needed to upholster chairs and 11 to 15 yards are needed for sofas. Based on about 30 million annual unit shipments (of

which perhaps about 53 percent are sofas, sofabeds, and loveseats and about 47 percent are other chairs) estimated annual upholstery material requirements are about 305 million linear yards. About 75 percent of total yardage (about 230 million yards) would be fabrics that might require FR treatment.

Comment: *The National Cotton Council (#25) commented that "since cigarette and open flame resistance are controlled by different mechanisms, light weight and some heavy weight cotton fabrics that are smolder resistant before treatment for open flame resistance may not be after treatment.*

Response: Some fabrics might be more prone to ignition from cigarette after FR treatments intended to improve resistance to small open flame ignition. However, the information from CPSC cigarette testing of chairs with treated fabrics indicates that, on balance, there will be an improvement in cigarette ignition resistance of fabrics as a result of the standard.

Comment: *The National Cotton Council (#25) commented that the "U.S. textile industry would essentially have to develop new FR-finishing capabilities and new processes for the almost infinite variety of currently used US upholstery fabrics.... This would necessitate large capital expenditures, which many small textile manufacturers would not be able to incur. It is uncertain, therefore, whether the US textile industry will produce many of these FR-treated fabrics or whether most will be produced outside of the United States.*

Response: It will be necessary for fabric manufacturers and those with expertise in FR treatment to work together to develop processes that impart flame resistance, yet minimize adverse aesthetic effects. As noted previously, most U.S. upholstery fabric currently is backcoated for reasons other than flame resistance, and the same equipment may be used for FR treatment of fabrics.

Comment: *The Society of the Plastics Industry, Inc. (#26) questioned the appropriateness of including projected reduction of cigarette-related fire deaths in the cost benefit analysis for an open flame ignition standard.*

Response: Since ignition testing shows a decrease in cigarette ignition propensity for upholstered furniture as a result of FR treatments designed to impart resistance to ignition from small open flames, inclusion of prospective benefits from a reduction in fires started by cigarettes is appropriate. According to the Flammable Fabrics Act, the Commission is required to consider all expected economic impacts of a regulation. The expected reduction in societal costs of cigarette fires certainly should be considered, just as an increase in cigarette ignited fires would be, if that would be the result of the standard.

B. Issues Raised After the Comment Period

1. Request by the Decorative Fabrics Association to Exempt Certain Decorative Fabrics

Comment: *The DFA, in a separate comment submitted on August 31, 2000, proposed that residential furniture items* ***upholstered with decorative fabrics*** *be exempt from the standard if the fabrics used meet these conditions:*

1. *sold as "Customers' Own Merchandise" or "Customers' Own Material" ("COM"), as a component of an interior decorating project;*
2. *sold to an ultimate consumer through an interior design professional (definition provided by DFA); and*
3. *where the decorative fabric either (i) has a published wholesale price of $20 per linear yard or more (approximately $40 at retail), or (ii) weighs 10 oz. per square yard or less.*

The DFA stated that these criteria provide the basis for distinguishing the types of fabrics sold by "DFA-type companies." The association states that CPSC epidemiological data show that households other than those purchasing decorative fabrics are at risk from furniture fires (and, by implication, their customers are not at risk). The DFA presented information in support of this contention at a June 28, 2000, meeting with CPSC staff. The DFA stated that approximately 80 percent of all sales by their members is of COM fabrics through professional designers, to households unlikely to experience furniture fires. Production of DFA members accounts for an estimated 1-1.5 percent of all residential upholstery, according to the DFA.

In addition to information purporting to show that households purchasing decorative fabrics through professional designers are not at risk, the DFA comments that its members would face disproportionate cost increases, because of the small fabric yardage that would be sent to independent fabric finishers for FR treatment and the higher cost of their fabric that would be devoted to testing. Additionally, DFA states that the types of fabrics marketed by its members would be more severely affected aesthetically by FR treatments.

Response: Analysis of upholstered furniture fire incident data shows a reduced likelihood that upper-income households and households without small children are involved in fires. Both household characteristics are very common for customers of DFA firms, according to information presented by the association. Nevertheless, fabrics marketed by DFA members present similar risks as other upholstery fabrics. Reliance on demographic data in this case to exclude products of a minimum price and marketed through specific channels is not warranted. This is especially true given the small share of the total market represented by these sales.

It is likely that most of the decorative fabrics that are the subject of the exemption requested by DFA would be used with acceptable barrier materials to manufacture furniture. Thus, the impacts on the costs to its members and on aesthetic characteristics

of their fabrics outlined by the DFA will not apply, although furniture manufacturers would incur costs related to the use of barriers.

2. Industry Sponsored Consultant Reports

In February 2001 the Commission received two reports sponsored by different industry groups that reviewed and commented on the 1997 staff briefing package on small open flame ignition of upholstered furniture. The American Textile Manufacturers Institute, the Decorative Fabrics Association, the American Fiber Manufacturers Association, the National Cotton Council, and the American Society of Interior Designers hired Glassman-Oliver Economic Consultants, Inc. (GO) to prepare a report, *An Economic Analysis of the Draft Small Open-Flame Regulation of Upholstered Furniture.* The Upholstered Furniture Action Council hired National Economic Research Associates (NERA) to prepare another report, *Assessing the Need for a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Flammability Standard.*

The 1997 briefing package was a status report on the staff work up to October 1997 on the petitions related to open flame and cigarette ignition of upholstered furniture. Part of the briefing package was a report, *Economic Considerations of Options for Addressing Small Open Flame Ignitions of Upholstered Furniture*, that summarized the preliminary estimates of the costs and benefits of various Commission options for dealing with the petitions. Most of the issues raised by the GO and NERA reports were discussed in the *Economic Considerations* report.

The GO and NERA reports attempt to show that CPSC staff have overestimated the projected benefits and underestimated the expected costs of a flammability standard. Unfortunately, these two contract reports taken together address issues that may have been relevant in 1997 but that are no longer relevant. They also commit major errors in estimates of costs or benefits, misinterpret staff procedures, conduct faulty statistical analyses, make unreasonable assumptions about analytic procedures, and are sometimes internally inconsistent.

a. Comments Regarding Estimated Benefits

The issues raised concerning benefits include estimates of fires, injuries, and fatalities; the value of a statistical life; the cost of injuries; discount rates and the methodology for estimating the benefits of a standard. Briefly, each of these issues can be examined as follows.

Estimates of fires, injuries and fatalities

Comment: *NERA criticizes CPSC's fire loss estimation methodology as relying on the National Fire Incident Reporting System (NIFRS) and the National Fire Protection Association (NFPA) data. The criticism is based on the claim that incidents in NFIRS are systematically different from those of the U.S. as a whole, that NFPA national estimates of fires losses are systematically biased, and that NFIRS codes for missing and partial information should not be used.*

Response: The U.S. General Accounting Office (GAO) found that fire departments participating in NFIRS were representative of the U.S. as a whole in terms of the size of the department and whether the department was paid or voluntary. The GAO also found that the NFPA estimates of fire deaths agree with the Centers for Disease Control and Prevention (CDC) estimates. The use of NFIRS codes for missing and partial information is accepted practice in fire loss estimation and has not been shown to be systematically biased.

Comment: *NERA claims that both cigarette-ignited and small open flame-ignited upholstered furniture fire fatalities will fall substantially in the absence of any further regulation.*

Response: NERA claims are inappropriate for several reasons. They make faulty projections by misusing statistical models and relying on unverifiable and optimistic assumptions. They misunderstand the effect of current standards and patterns related to residential fires. They fail to employ accepted epidemiological practices. [For a fuller critique of NERA's assertions on these topics see the March 2001 memorandum from the Hazard Analysis Staff to Dale Ray, Project Manager for Upholstered Furniture.]

Value of a statistical life

Comment: *NERA, in Appendix 4 of the report, claims that the staff assignment of a statistical value of life of $5 million is too high (a higher value of life implies that the societal costs of fires and, therefore, the potential benefits of a standard are higher). They cite earlier studies where CPSC used lower values, some non-CPSC studies that employed lower values, and they also say the values of life should be age adjusted.*

Response: Prior to 1994, CPSC staff used lower values for a statistical life, but since the 1993 survey article by Kip Vicusi that is cited by NERA, CPSC has been using the $5 million value. This value is well within the range of values employed by several different studies including a recent EPA study on regulatory procedures involving arsenic in water that uses $6.1 million.

There is no justification for the age adjustment suggested by NERA of $3.5 million based on valuing people over 65 at $4 million and $3 million for younger people. Some may suggest that younger people who have more years of life remaining should be valued higher, but CPSC staff does not make value judgements about the relative value of different peoples' worth.

Cost of injuries

Comment: *NERA says that the CPSC staff relies on a high injury cost estimate. (A higher injury cost results in higher societal costs of fires and higher potential benefits of a standard.)*

Response: As NERA says, estimating the cost of injuries is a complex and controversial task. As with most serious injuries, the pain and suffering components of economic costs are very high relative to the other costs such as direct medical expenses or losses of productivity. Burn injuries are exceptionally painful and often leave the victims scarred or disabled for life. As it turns out, much of the difference in injury costs between CPSC staff estimates that are based on a 1993 study by the National Public Services Research Institute and NERA's cited studies are explained by the pain and suffering component. However, even if the NERA estimates were used to analyze societal costs, the $27 million difference in total injury cost is only about 2 percent of projected gross benefits.

Discount rate

Comment: *Both GO and NERA claim that the rate (2.5 percent) at which future benefits were discounted in the 1997 study to arrive at the present value of benefits is too low (the lower the discount rate, the higher the benefits).*

Response: Although CPSC staff are currently discounting benefits at 3 percent, as reflected in the *Economic Analysis of Regulatory Options* that is part of the staff's Regulatory Options Package, rates in the 1 to 3 percent are considered appropriate. Dr. Kip Viscusi, who served as a reviewer of the NERA report, has published papers that say that 3 percent is appropriate for discounting health effects. A recent (March 2001) memo from OMB to agency heads says, "the social rate of time preference reflects the discount rate at which society is indifferent between a payment now and a correspondingly larger payment in a future year." The memo goes on to say that the "economics literature identifies the government borrowing rate as a good measure of the social rate of time preference and most analysts use the average rate on long-term Treasury bonds. In recent years, this rate has been roughly 3 percent."

The higher rates that GO and NERA suggest are usually associated with discounting streams of expenditures associated with capital outlays rather than health and safety benefits. In those instances when capital outlay expenditures are being discounted the appropriate rate is the before-tax rate of return to incremental private investment, which has recently been about 7 percent.

Methodology for estimating benefits of the standard

Comment: *GO claims that annual benefits of the standard are only about 1/14 of CPSC staff estimates.*

Response: GO's failure to understand that CPSC staff compares the costs and benefits associated with a single year's production led them to believe that benefits were attributed to all furniture in use by consumers. GO proceeded to divide CPSC staff's benefit estimate by 14.

GO's mistake results in benefits that are over $400 million per year not being counted. Once corrected, their conclusions that the costs exceed the benefits are no longer valid.

b. Comments Regarding Estimated Costs

The principal issues related to the costs of the standard concern estimates of how much fabric may be treated with FR chemicals to meet a flammability test, the costs of treatment, and the cost of testing. In each of these areas both GO and NERA attempt to demonstrate that CPSC has consistently underestimated the costs of complying with a standard. These are discussed below.

Comment: *GO claims that staff cost estimates are too low. GO conducted a survey of fabric mills and finishers to obtain information that leads them to conclude that the costs of applying backcoating and testing are much higher than staff estimates.*

Response: GO's survey resulted in responses that do not represent the market for fabrics likely to be used on most furniture. The respondents reflect small firms that are likely to incur high costs if they treat fabrics rather than have the work done by contract finishers. Much of the production of smaller firms may be the types of fabrics most likely to be used with barrier materials, and would not be FR-treated.

CPSC estimates came from discussions with industry sources. The experience of the UK provided relevant retrospective information with which to consider the likely impacts of the similar CPSC standard.

Comment: *NERA claims that CPSC staff understated the fabric FR treatment costs. Information provided to NERA by fabric manufacturers and FR treatment firms indicates that treatment costs for cellulosic fabrics may be between $1.80 and $3.15 per linear yard; costs to treat thermoplastic and blended fabrics may be between $1.15 and $1.40 per linear yard. These estimates contrast with the treatment costs estimated by the CPSC staff in the "Economic Considerations" paper that ranged from $1.00 to $1.25.*[2]

Response: The staff believes that the experience in the UK, where there is widespread use of FR treatment to pass a test that is comparable to that in the CPSC standard, is relevant for estimating costs that would be incurred in the U.S. The UK experience provides retrospective data on the impacts of a standard that achieves compliance through FR treatments of fabrics. In addition to the retrospective data from the UK, a U.S. firm that applies FR backcoating to upholstery fabrics provided cost estimates that are within the range obtained by converting UK estimates to U.S. equivalents.

Comment: *NERA application of per yard costs to the total amount of woven fabric (currently estimated at 433 million linear yards) results in compliance costs of between $586 million and $842 million.*

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[2] Average FR treatment costs estimated in the CPSC staff's March 2001 *Preliminary Regulatory Analysis* range from $.62 to $1.05 per linear yard of fabric.

Response: NERA apparently relies on estimates of U.S. consumption of residential upholstery fabrics based on fabric production. This overstates the potential impact of the standard because there are other markets for these fabrics that will not be subject to the standard. Furthermore, a large percentage (perhaps 20 percent) of upholstery fabric production by U.S. firms is exported.

As noted in response to a comment filed earlier by ATMI (see page 8) an independent report by Keyser Ciprus, Ltd., Inc., leads to an estimate of total upholstery fabric yardage used in the manufacture of residential upholstered furniture of about 238 million linear yards in 1997. Using another estimation method (based on average yardage requirements per chair and sofa), annual consumption of upholstery fabric that might require FR treatment is estimated to be about 230 million linear yards.

Based on these two ways to estimate residential upholstered furniture fabric consumption, the staff considers NERA estimates of compliance costs to be overstated by about 85 percent, just on the basis of estimated yardage affected.

Comment: *NERA says that industry will be required to submit fabrics for testing to ensure compliance. Based on a NERA survey of laboratories and discussions with other industry experts, NERA estimates that this process will cost approximately $70 to $220 per test (including testing fee of $50-$200, fabric cost of $7/linear yard, and foam cost of $5 for 1 cubic foot of foam). Assuming tests are required at the textile manufacturing level, NERA estimates that approximately 40,000 tests will be conducted annually at a cost of $3-$9 million (higher costs were estimated based on an assumption that furniture manufacturers conduct the tests).*

Response: NERA estimates that 40,000 tests will be done annually based on 30,000 fabric styles with an average of 4 colors each and 1/3 annual turnover. NERA's estimate assumes a testing fee of $50 to $200. The highest fee reported to CPSC by fabric manufacturers that were contacted was $150. In a February 2001 report prepared for the American Textile Manufacturers Association, Glassman-Oliver Economic Consultants, Inc., reported an average fee of $135 for firms it surveyed. Based on a range of outside laboratory testing fees of $70 to $150 per test (from the current CPSC *Economic Analysis*), the other assumptions by NERA lead to estimated annual testing costs of about $3.6 to $6.8 million.

Nevertheless, the staff disagrees with NERA's assumption that testing costs based on fees charged by third party laboratories, and determined by the number of fabric styles and colors, represents industry practice under the standard. Based on the retrospective evidence provided by the response of the UK textile industry to a similar standard, it is likely that most of the testing that will be done under the standard will be by personnel of the firm that does the FR treatment (whether a fabric producer or a fabric converter) at its facility. Further, the staff believes that testing will be dependent on yardage that is treated, rather than the number of fabric styles and colors.

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: April 16, 2001

TO : Dale Ray, Project Manager, Upholstered Furniture
Directorate for Economic Analysis

THROUGH: Sue Ahmed, Ph.D., Associate Executive Director
Directorate for Epidemiology

FROM : Michael Greene, Ph.D.
Mark S. Levenson, Ph.D.
Russ H. Roegner, Ph.D., Director
Linda E. Smith
Division of Hazard Analysis

SUBJECT : NERA Report on Upholstered Furniture Flammability Standard

1. Introduction

In 1997, the Consumer Product Safety Commission (CPSC) voted to direct staff to develop a notice of proposed rulemaking to address the risk of small open flame ignited upholstered furniture. A central factor in such a decision is the balance of anticipated costs and benefits of the proposed rule. The determination of these figures is a complex problem that makes extensive use of statistical and economic methodologies and relies on many sources, such as national databases, laboratory analyses, and technical publications, and relevant experiences.

In February of this year, National Economic Research Associates (NERA) issued a report for the Upholstered Furniture Action Council (UFAC), titled *Assessing the Need For a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Standard.* The report among other things criticizes CPSC costs and benefits estimates. In particular, it calls into question the CPSC's assumptions and methodologies. It is the purpose of this memo to address the NERA report with regard to the estimation and projection of the fire losses associated with upholstered furniture fires. These losses are the basis of the benefits side of the proposed rule.

The NERA report is a large document with unsubstantiated claims, weak and contradictory assumptions, and misleading use of statistical modeling. Additionally, as the cover letter from UFAC points out, the results are not based on the most recent methods and analyses of CPSC. Much of the report is therefore not relevant or does not have significant consequences. For example, the report devotes a large amount of attention, including an appendix, to the review of the University of Surrey report on the

effectiveness of the United Kingdom furniture standard (the "Surrey Report"). However, the Surrey Report does not play a role in the current CPSC cost-benefit analysis.[1] Likewise, there is discussion on the need to exclude arson incidents from fire loss estimates. Under CPSC's revised methodology, arson incidents are not included in the fire loss estimates.

The apparent contradictions in the NERA report are a troubling aspect of the report. NERA claims that small open flame ignitions of upholstered furniture fatalities have dropped since 1980.[2] However, in their analysis of the situation in California, they note there has been no downward trend in such fatalities in California.[3] That difference is not in itself a contradiction, but since California makes up a significant portion of the U.S. population the difference is more than a little bit surprising. More so, the report includes much material on how such losses can be expected to decrease as smoking prevalence decreases and also notes California smoking prevalence is consistently among the lowest in the U.S. There are other similar contradictions, some of the relevant ones will be discussed below. However, there is a general pattern in the NERA report to provide a set of assumptions and an analysis that support a particular point even if it contradicts those in other parts of the report.[4]

Rather than address all of the NERA report, we will concentrate on the areas that have significant consequences on the fire loss estimates and thus the benefits side of the cost-benefit analysis. The remainder of this memo is divided into three sections addressing the following issues.

- NERA's methodology for making fire loss projections. NERA uses several models for making the fire loss projections. The projections are key to determining the future benefits of the proposed rule. However, NERA makes critical misuses of the models. They extrapolate well beyond the available data and assume causal relationships, where none have been established. Additionally, they make optimistic assumptions that favor their position.

- NERA's claims that other factors will decrease fire losses. Besides the optimistic and causal assumptions on smoking prevalence, NERA argues recent standards for cigarette lighters and emphasis on smoke detectors will result in a decrease in fire losses in addition to any observed trends. However, NERA misunderstands the effect of the lighter standard and other factors affecting fire losses.

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[1] NERA states (p. 46) that CPSC uses the Surrey as a basis for the estimate of the effectiveness of the CPSC upholstered furniture standard. The CPSC estimate is currently based on laboratory experiments.
[2] NERA Report, p. 19.
[3] NERA Rport, p. 62.
[4] Other examples of contradictions include (1) the criticism of the use of linear trends for fire fatality data in the Surrey report (p.108), although linear trends are use throughout the NERA report and (2) the projection of candle fire related fatalities as a constant percentage of the population (p. 36), although NERA makes use of the increasing trend in candle fatalities (p.15).

- NERA's criticism of CPSC fire loss estimation methodology. NERA criticizes the accuracy of the two primary sources of fire data in the U.S. They also claim our methodology with regard to the use of these data is flawed. However, several independent results validate these data. In addition, CPSC methodology has evolved to make prudent use of these data.

2. NERA's methodology for making fire loss projections

The largest factor in the NERA analysis that drives their reduced benefits estimate is the projection of fatalities for cigarette ignited upholstered furniture. They provide a range of projections from 169 to 262 for such fatalities in the year 2003. This section will address the validity of these projections from a modeling perspective. It will not address the validity of the historical estimates that NERA uses to fit the models. In a latter section, we defend the methodology used to produce the CPSC historical estimates.

In the interest of brevity, we will concentrate the derivation of the lower and therefore more consequential projection, i.e., the 162 figure. This projection is based on a model of cigarette related fatalities as a function of smoking prevalence. Figure 1 displays the data used to fit the model. The two vertical lines represent NERA's assumed smoking prevalence in the years 2003 and 2010. NERA fits a model that relates the log of the fatality rate to a linear function of the log of the prevalence rate. We refer to such a model as a LogLog model. The R^2 for the fit is .83, which should be compared to a value of 1 for a perfect fit.

There are several critical problems with the projections. First, the model is fit for a certain range of smoking prevalence values and is used to project to values well outside the range. Statisticians are often wary of extrapolation, as opposed to interpolation. One measure of the degree of extrapolation is that the smoking prevalence values assumed in 2003 and 2010 are 4.2 and 6.4 standard deviation units from the mean of the data used to fit the model. This is considered rather extreme. The value of R^2 has no bearing on the validity of predictions outside the range of the data used to fit the model.

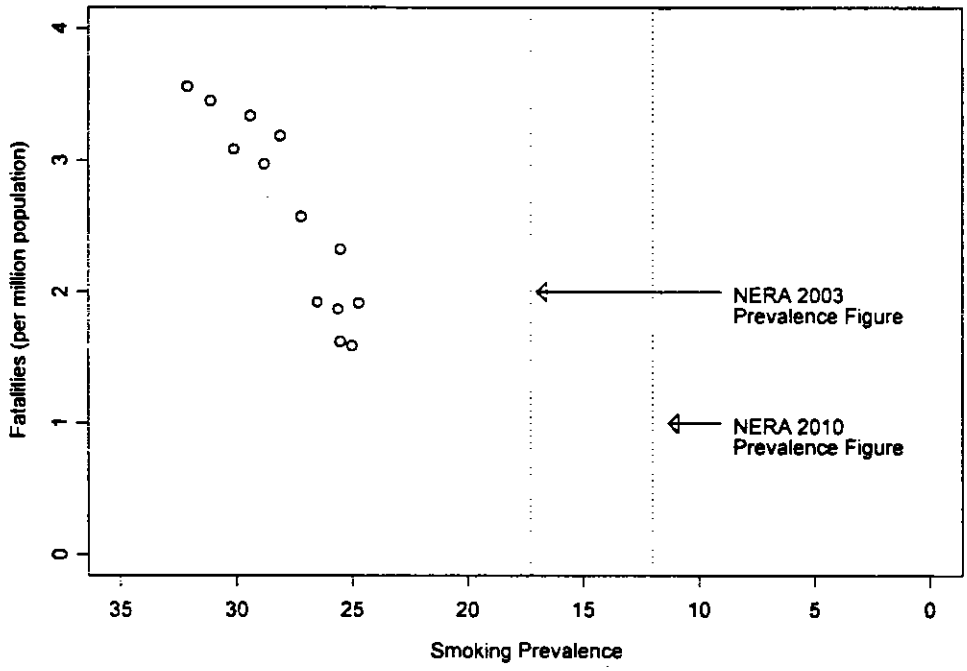
Without an established cause and effect relationship between the fatality rate and the prevalence rate, NERA's extrapolation is dangerous. Note that both variables are highly correlated with time. Other factors changing over time may be the true cause of the patterns in the two variables. Even if the model can be assumed to represent the variables in the range of the observed data, there is no reason to believe the same mechanism will function at lower smoking prevalences. To give one scenario, the smokers who remain may be different from those who have quit. They may be lower income people, who NERA states are more likely to be involved in such a fatality. A model that gives greater weight to recent data would be an improvement.

Available data on smoking prevalence by education attainment supports this scenario.[5] Figure 2 presents the data on smoking prevalence for all persons over 25 years and

[5] Source: National Center for Health Statistics, Health, United States, 2000.

persons over 25 year with less than 12 years of education. The lower education group has higher prevalences. More importantly, the rate of decrease of this group is lower than that of the overall group. In relative, and even more striking in absolute terms, the decrease in smoking prevalence is less for the lower education group.

Figure 1: Cigarette Fatalities By Smoking Prevalence.



To further show the lack of robustness in extrapolation, we fit several models similar to the NERA model. Figure 3 shows the fitted models. The NERA model is the LogLog model.[6] All of the models have R^2 greater than 0.80. The best fitting model is actually a linear model. Two other models result in higher projections than the NERA models. In fact from a model diagnostic perspective, all the models are poor, because the concavity of the data is negative, and all the models except for the linear model have a positive concavity. The fact that all these models and even unrealistic models fit the data well in the observed range further demonstrates the perils of NERA's extrapolation.

[6] The Linear model expresses the fatality rate as a linear function of smoking pravalence. The LogLin model is the same except that the log of the fatality rate is used. The final model, LogLinOff, is similar to the LogLin model, except, it includes a constant offset to the prevalence rate, which allows the curve to approach a nonzero value.

Figure 2: Smoking Prevalence By Education.

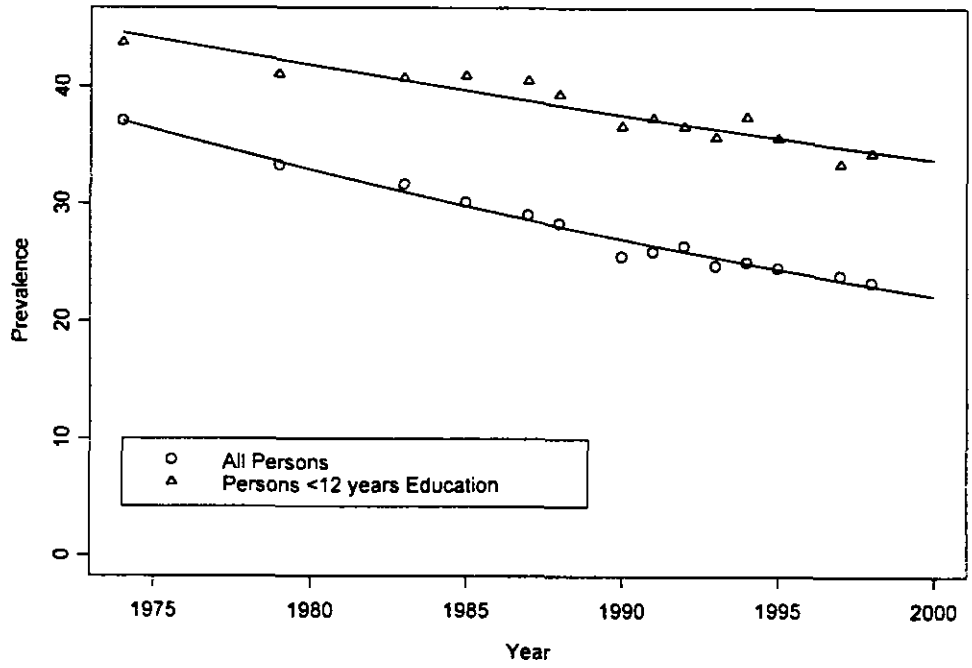
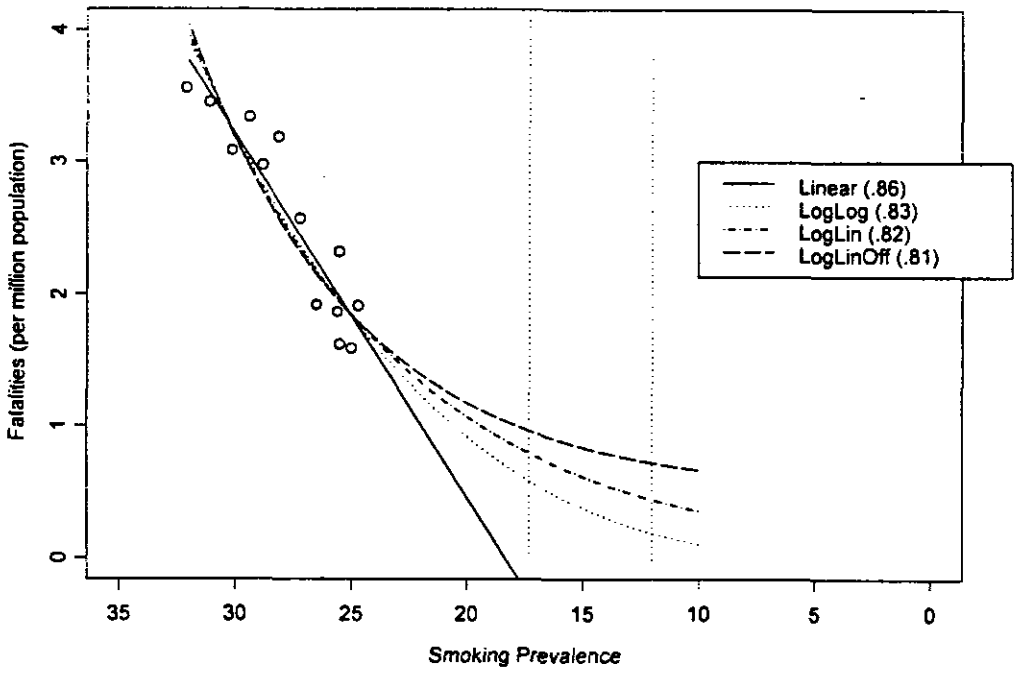


Figure 3: Cigarette Fatalities By Smoking Prevalence.



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One final point is that the predictions are all based on the assumed smoking prevalence in 2003 and 2010. These assumptions, particularly the 2010, may be optimistic.

3. NERA's claims that other factors will decrease fire losses

NERA claims other factors will reduce fires losses without any CPSC standard. This section will address three factors discussed in the NERA report that have bearing on the anticipated fire losses associated with upholstered furniture.

Effect of the Cigarette Lighter Standard

NERA states that the Cigarette Lighter Standard (requiring child resistant cigarette lighters) and the more recent multi-purpose lighter standard will clearly lead to further reductions in small open flame fatalities.[7] NERA's analysis is misleading.

- It is believed that by 1998, the year upon which CPSC's estimate was based, child resistant lighters already had replaced virtually all non-child resistant cigarette lighters in households. Therefore, although the cigarette lighter standard will continue to prevent fires in subsequent years, it is not expected that the degree of effectiveness will increase. Thus, the only additional reduction due to lighter regulation that it is reasonable to expect in future years is the reduction caused by children younger than age 5 using multi-purpose lighters. There were an estimated 20 such deaths in this category in 1998.

- NERA speculates that the effectiveness of the CPSC cigarette lighter standard may be lower than estimated by CPSC. It is not clear why NERA chooses to question the effectiveness in this context. Even if the estimate of effectiveness was adjusted, it would not change the estimates of current losses. The estimate of the standard's effectiveness was derived from the current loss estimates and not the reverse.

- CPSC's estimate of effectiveness (67 percent) applies only to fires caused by children younger than age five, rather than all lighter child play fires. Child play fires caused by children age five and older are thought to be largely unaffected by the standard.

Future Fire Losses Involving Candles

Citing industry data, NERA acknowledges that candle ignited fires have increased in recent years and that this is related to the increased popularity of candles. They state that the industry claims a growth rate of 10 - 15 percent annually since the early 1990's and that in recent years, the growth has doubled. In spite of the increased sales, NERA chooses to use fire fatalities per million U.S. population, rather than fatalities per unit sold as a basis for forecasting fatalities. The result is an inappropriately low estimate of future fatalities.

[7] NERA Report, p.35.

NERA suggests that candle-related fatalities will be reduced in the future as a result of CPSC's request to ASTM to develop a standard addressing candle fires. To date, ASTM has published voluntary standards for cautionary labeling of candles and a guide for terminology related to candles and accessories. CPSC has requested additional efforts to address fire and burn hazards from exploding, shattering and sparking but it is not clear when or if such actions will occur. NERA chooses to take the optimistic viewpoint that actions to address candle performance will be taken by the candle industry. If they do not, only voluntary labeling will be in place, which can be expected to have a minimal effect at best, particularly in the face of rapidly rising candle sales. All things considered, fatalities would be more likely to rise than fall.

Table 9 is somewhat deceptive for candle fatalities. The prediction is based on the years 1995 to 1998. However, the estimates for 1995 are not shown. In that year, there were no candle related fatalities. Even by NERA estimates there were over 20 fatalities in each of 1994 and 1996. NERA chooses to include years back to an anomalous year, but not beyond.

Use of Smoke Alarms to Reduce Fire Fatalities

Similar to the statements on candles, NERA exhibits only optimism about the ability of education to improve the percentage of fires in which an operating smoke detector is present. They talk about greater enforcement of smoke detector maintenance without citing any programs that show how this will work or acknowledging the difficulties involved in achieving effective education over the long term.

NERA assumes that smoke detectors are uniformly effective for all kinds of fire casualties. National fire data indicate that children younger than age 5 die in fires at more than twice the rate of the population overall.[8] Thus, whenever a fire is ignited by a child of this age, it is to be expected that an enhanced risk of fatality exists. CPSC's evaluation of the lighter standard pointed out the increased vulnerability of all children when a fire occurs, not only the children at the point of origin but other children as well. That evaluation also indicated that a minimum of 28 percent of the children who started fires with lighters did not alert anyone else to the fire. Some children hid and could not be rescued in time. While the presence of an operating alarm was beneficial overall, the inappropriate response of the fire starter can be expected to reduce the effectiveness of smoke alarms to prevent fatalities in child play fires compared to many other kinds of fires.

NERA also compares smoke alarm performance in the U.K. and the U.S. They state that there is no reason to expect differences in smoke detector performance between the two countries. Without supporting justification, NERA assumed that the U.K. smoke alarm performance data included in the Surrey Report was wrong, and proceeded to derive adjusted estimates of effectiveness which NERA describes as "more accurate". Actually,

[8] Hall, J., *Patterns of Fire Casualties in Home Fires by Age and Sex*, National Fire Protection Association, April 2000.

there are a number of factors that may explain differing performance. The Surrey Report indicates that in 1997, only 73 percent of UK households had an alarm installed. In the U.S., 94 percent of households had a smoke alarm in 1997.[9] In the U.K. it may be more common for dwellings to have rooms separated by doors than in the U.S. If doors are closed, the effectiveness of a single alarm in detecting a fire will be reduced. Alarms not in the room of fire origin may not sense the fire until too late for the occupants to escape. Thus, the placement issue dismissed by NERA may in fact be a more significant issue in the UK than in the U.S. Related to the placement issue, the likelihood that an alarm will sound in a household becomes greater as the number of alarms present increase. NERA provides no information on the proportion of households considered to have an adequate number of alarms, which could be quite different than in the U.S.

4. NERA's criticism of CPSC fire loss estimation methodology

The NERA report is very critical of the methodology used by CPSC to estimate fire losses. They, however, admit the methodology has "gained general acceptance".[10] Before addressing NERA's points, we state the objective of the fire loss estimation. CPSC seeks to give the best estimate of a fire loss. We are not interested in being conservative on the side of underestimating or overestimating a loss. We accept that any estimate has uncertainty associated with it. However, we are not aware of any biases in the estimates that make them unduly high or low.

The CPSC methodology has been described in many places.[11] It makes use of two sources: the National Fire Incident Reporting System (NFIRS) database and the National Fire Protection Association (NFPA) annual survey of fire losses. NFIRS provides detailed information on fire incidents and is believed to be representative of U.S. fires. However, it does not include all the fires that occur in the U.S. The NFPA survey is a probability sample that provides summary information on fires at the national level. The NFPA estimates are used to scale the NFIRS estimates to the national levels. Another component of the methodology is to allocate undetermined outcomes in NFIRS based on the observed outcomes.

NERA criticizes the methodology throughout the report, but their points are summarized in Appendix 1. NERA states that the incidents in NFIRS may be systematically different from those of the U.S. as a whole. They suggest that fire departments in rural areas may not have the resources to participate in NFIRS. However, they do not provide any examples of observed biases. The U.S. General Accounting Office (GAO) report found that departments participating in NFIRS were representative of the U.S. in two important measures: the size of the department and whether the department was paid or volunteer.[12] To overcome reporting differences in NFIRS, CPSC scales each of the four primary loss

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[9] Ahrens, M., *U.S. Experience with Smoke Alarms and Other Fire Alarms*, National Fire Protection Association, January 2000.

[10] NERA report, p. 94.

[11] See Hall, J, Harwood, B. "The National Estimates approach to U.S. Fire Statistics" *Fire Technology*, 25 (2), 1989.

[12] *Additional Steps Needed To Assess Fire Hazards of Upholstered Furniture*, U.S. General Accounting Office, November 1999.

measures, (fires, deaths, injuries, and property loss) separately based on the corresponding measure from the NFPA survey.

NERA points out that the NFPA results are based on a survey and are thus "not an exact portrayal." Obviously, NFPA is a survey. It is a stratified probability survey. It is subjected to what is known as sampling variation. However, this does not imply that there are any known systematic biases. Again, NERA does not provide an example of an observed bias. The GAO report compared the NFPA survey estimates of deaths to the Centers for Disease Control and Prevention estimates and found that they were in reasonable agreement.

NERA criticizes the procedure of allocating the undetermined outcomes based on observed outcomes in NFIRS. This procedure is done at two levels, referred to as the first and second stage allocation. Consider the NFIRS variable–*Form of Heat of Ignition.*[13] There are 65 different two-digit codes grouped into 9 categories. The categories represent similar outcomes. For example, codes that begin with the digit 3 correspond to smoking materials. The code 00 corresponds to "Form of Heat of Ignition undetermined or not reported." Incidents with code 00 are allocated to the remaining codes based on the proportion of observed outcomes. If some codes occur very often, they will be allocated a greater proportion of this code than for codes that do not occur very often. Note that there are distinct codes in NFIRS for incidents that cannot be classified, e.g. code 99 corresponds to "Other Form of Heat of Ignition not classified above." The "unknown" code is not used for this purpose.

Within each of the 9 categories are codes that provide partial but not complete information. For example, code 39 corresponds to "Heat from Smoking Material not classified above" and code 30 corresponds to "Heat from Smoking Material; insufficient information available to classify further." In the second stage, the incidents with the code 30 are allocated to the other codes for smoking materials based on the observed proportions. For example, based on the observed proportion more of these incidents will be allocated to code 31 (Cigarette) than to code 33 (Pipe). Some will even be allocated to code 39 (Heat from Smoking Material not classified above).

These allocations are based on the clear and intended use of the NFIRS codes. Particularly, in the case of the secondary allocation, it is hard to argue that the procedure does not remove systematic bias, let alone that it may add bias, as NERA suggests. Failure to perform these allocations would result in estimates that are inappropriately low.

As NERA acknowledges, CPSC now removes incidents based on an NFIRS variable that are determined or suspected to be acts of arson.[14] This is done for all fire loss estimation. For the upholstered furniture estimates, additional effort is made to remove cases with coding inconsistencies.

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[13] See *Uniform Coding For Fire Protection*, National Fire Protection Association, No. 901, 1976.
[14] NERA Report, p.13.

CPSC accepts that the fire loss estimates have uncertainty associated with them. However, we believe they represent the best point estimates available and do not contain any known systematic biases. NERA's suggestion that it may be prudent to rely on estimates excluding this allocation [primary allocation]" clearly would result in estimates that are biased very low.[15] It would be unreasonable and misleading to assume that none of these fires involve upholstered furniture.

5. Conclusion

NERA claims that fires losses from upholstered furniture are low and will drop further without any intervention on the part of CPSC. However, NERA's analyses and arguments are significantly flawed and do not demonstrate their claims.

- NERA uses several models for making the fire loss projections. The projections are key to determining the future benefits of the proposed rule. However, NERA makes critical misuses of the models. They extrapolate well beyond the available data and assume causal relationships, where none have been established. Additionally, they make optimistic assumptions that favor their position.

- NERA argues that certain factors such as recent standards for cigarette lighters and emphasis on smoke detectors will result in a decrease in fire losses in addition to any observed trends. However, NERA misunderstands the effect of the lighter standard and other factors affecting fire losses.

- NERA criticizes the accuracy of the two primary sources of fire data in the U.S. They also claim our methodology with regard to the use of these data is flawed. However, several independent results validate these data. In addition, CPSC methodology has evolved to make prudent use of these data.

[15] NERA Report, p.12.

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: March 22, 2001

TO : Dale Ray, Project Manager, Upholstered Furniture

THROUGH : Hugh McLaurin, Associate Executive Director
Directorate for Engineering Sciences
Dr. Robert Ochsman, Division Director
Division of Human Factors

FROM : Carolyn Meiers, Engineering Psychologist

SUBJECT : Response to National Economic Research Associates (NERA) Regarding Upholstered Furniture Fires

The Upholstered Furniture Action Council (UFAC) consulted with NERA concerning the U.S. Consumer Product Safety Commission's (CPSC) stance on the economic considerations of mandating a flammability standard for upholstered furniture. Human Factors staff was asked to respond to the following statement that NERA made in their rebuttal of the issues. "Children playing with lighters or matches, if unsuccessful in igniting furniture, may turn to the curtains or the pile of newspapers in the corner. Thus, although furniture fires may fall, other types of small open flame fires may increase." NERA cites three CPSC IDIs as supporting this type of behavior.

Human Factors staff interprets the statement to mean that NERA believes children are willfully trying to set upholstered furniture on fire and if they are not successful in this attempt they will try to ignite other household items. Human Factors staff disagrees with this concept based on research referring to child firesetting behavior in the United States Fire Administration's (USFA) Preadolescent Firesetter Handbook and on an analysis of the IDIs cited by NERA.

CPSC data show that the majority of furniture fires are started by children under five years of age. USFA research indicates that while this age group of children show a normal curiosity about fire, they do not understand the destructive consequences of fire. They exhibit "curiosity firesetting" behavior by experimenting with fire in their environment. These children want to know how fire feels, how it looks, how hot it is, how it burns, and what it does. The fires set by this group of children most likely can be termed "accidental" meaning that the fires are incidental to the experimentation and are not a goal in themselves. CPSC investigations of fire incidents indicate that these children are taken by surprise when their efforts result in a fire and their responses may vary from informing adults to hiding from the fire.

Human Factors staff was able to attain two of the three IDIs cited by NERA. Human Factors staff does not believe that the IDIs support NERA's contention that children will start other items on fire if furniture does not ignite. IDI # 951006HCC1005 refers to a fire started by a child with

a disposable lighter in a bedroom. The child died in the fire. Fire investigators determined there were two ignition sites for the fire, the curtains and a sofa. However, there can be no conclusion drawn about a child's motivation to ignite a second site. IDI #961114HCC5048 involved the ignition of a pillow on a sofa by a child using a multipurpose grill lighter. The investigation could not determine if the pillow was a separate item on the couch or one of the pillows integral to the sofa design. Again, there can be no conclusion drawn about a child's motivation to ignite a second site given the information provided by the investigation.

TAB J

Upholstered Furniture Small Open Flame Ignition Resistance Standard:

Environmental Effects

Robert Franklin, Economist
October 2001

Upholstered Furniture Small Open Flame Ignition Resistance Standard: Environmental Effects

Introduction

This environmental report discusses the possible environmental effects that may result from implementing the staff's draft standard. A screener developed for the Commission for use in assessing the environmental impacts of its actions is included in the appendix.

The Draft Standard

The draft standard provides manufacturers of residential furniture two options for meeting the standard. One option is that all fabric used in residential furniture be able to pass a small flame performance requirement. The other option is for the manufacturer to use a barrier between the cover fabric and the filling materials that is capable of preventing the combustion of the filling materials.

The small flame tests involve installing samples of the fabric onto a fabric and foam test mockup. The mockup is exposed to a flame at several locations, as specified in the test, for 20 seconds. In order for the fabric to pass, any combustion must cease within 2 minutes after the flame source has been removed. If a fabric is treated with a flame-retardant chemical, the fabric must be soaked in water for a specified period of time prior to testing to ensure that the fabric will retain its flame resistance if the fabric is washed. If a fabric is to be used as a dust cover, it is installed on a horizontal frame and impinged with a gas flame for 20 seconds. The fabric must cease combustion within 2 minutes of the flame being withdrawn. And if a dust cover fabric develops any holes during the testing, the fabric cannot be used as a dust cover in furniture constructions that would have flammable material less than 1 inch above the dust cover.

In order to comply with the draft standard, furniture manufacturers will most likely use upholstery fabrics that have been treated with flame retardant (FR) chemicals. For most upholstery fabrics, the treatment will be either the application of a backcoating that incorporates FR chemicals or an immersion treatment of the fabric with FR chemicals. However, a few materials, such as leather, wool, and some vinyls, may be able to meet the standard without any FR treatment.

Some manufacturers may choose to use fire-blocking FR barriers instead of, or in addition to, FR-treated fabrics. The standard specifies another test for barriers that some manufacturers may use instead of subjecting the cover fabrics to the small flame tests. In some cases, barrier fabrics may be inherently flame-resistant. However, other barriers will consist of a fabric that has been treated with flame-retardant chemicals, similar to the treatments used for the upholstery cover fabrics.

Environmental Effects

Any adverse impact on the environment resulting from the standard is likely to follow from the increased use of FR chemicals and especially their use in applications where there has been minimal

use of such chemicals in the past. According to the American Textile Manufacturers Institute (ATMI) less than 0.2 percent of all U.S.-produced fabric is currently treated with flame retardant chemicals. And, of the fabric that is currently treated, most is used in protective apparel and airline or other transportation upholstery applications (CF-1-22). FR chemicals have not been used in residential upholstery fabrics in the U.S. Therefore, the standard will result in an increased demand for FR chemicals and it will result in materials treated with these chemicals being used in facilities that have not had previous experience with FR chemicals. Furthermore, although consumers already use many products that incorporate the same FR chemicals, the standard may create different exposure patterns.

This analysis is organized according to the "life cycle" of FR chemicals used in upholstery fabrics. It includes a discussion of the types of environmental exposures or releases that may occur at each stage of the life cycle, how the standard may impact these exposures, and whether a significant adverse environmental impact is likely to occur. The life-cycle stages are:

- the manufacture of the FR chemicals;
- the formulation of the FR systems;
- the use of FR chemicals by fabric finishers;
- the handling of FR fabric by furniture manufacturers;
- the distribution of furniture containing FR-treated fabric; and
- the use of furniture by consumers.

The Manufacture of FR Chemicals

FR chemicals are manufactured from various raw materials. Environmental releases of these raw materials may occur during the mining or extraction of the raw materials or their transportation to the facility where they are processed. The manufacture and processing of the raw materials and the manufacture of the FR chemicals may also involve the use of other materials and resources to purify or otherwise process the chemicals. These other materials may also be released into the environment.

Some of the chemicals that may be released into the environment have the potential for causing adverse environmental impact. For example, several experts have expressed concerns that some bromine-based FR chemicals may be bio-accumulative.[1] However, the marginal increase in the production of FR chemicals caused by the standard is unlikely to have a significant impact on the environment. The chemicals are already widely used in various applications in industry and their use has been increasing. For example, the U.S. consumed 163 million pounds of bromine-based FR chemicals in 1995. By 1998, U.S. consumption had grown to 208 million pounds and may reach 313 million pounds by 2003. The consumption of antimony-based and phosphorous-based FR chemicals has also been growing at annual rates of 2 to 7 percent. By 2003, the total U.S. consumption of all FR chemicals is expected to be about 969 million pounds.[2] CPSC estimates that the standard would

[1] For example see, Jacob de Boer, Peter G. Wester, Hans J.C. Klamer, Wilma E. Lewis, and Jan P. Boor, "Do flame retardants threaten ocean life?" Nature, 02 July 1998.

[2] Flame Retardant Chemicals, Report C-004Z, Business Communications Company, Inc., Norwalk, CT, Richard Hilton, Project Analyst, October 1998.

increase the consumption of FR chemicals by 25 to 30 million pounds annually,[3] or less than 5 percent of total current U.S. consumption of FR chemicals. This is roughly equal to the current annual rate of growth in the consumption. It is unlikely that the increased consumption due to the furniture standard would cause any new adverse or irreversible environmental impacts.

The Formulation of Fire Retardant Systems

After the individual chemicals are manufactured, they are shipped to a formulator to formulate the FR system. This process may include combining more than one FR chemical (e.g., antimony oxide and decabromodiphenyl oxide) and other components, such as polymers for a backcoating. Formulators often blend chemical systems or formulations for various users. In some cases, a fabric finisher may formulate its own systems.

The FR chemicals themselves may be either solid or liquid when received by the formulator. If they are in a solid form, usually powder or granules, the formulator will sometimes have to further grind, crush, or sift the chemical. The chemical is often stored suspended in a liquid in a vat, tank, or other vessel.

The individual chemicals will then be mixed with other chemicals to form the system that will be used on the fabric. In many cases this will be a form of backcoating; in other cases an immersion treatment may be used. The different chemicals will be combined and mixed in a vat. This may include the FR chemicals, chemicals that may be needed for other purposes (perhaps 60 percent of upholstered furniture fabric in this country already has a non-FR backcoating), and the polymers that actually form the backcoating. After being mixed the formulation will be transferred to tanks or drums and transported to the finisher for application.

The tanks and vats used for containing and mixing the chemicals must be cleaned from time to time. This involves washing them out with water. The wastewater will contain some of the FR chemicals. Depending on the characteristics of the chemicals, some may be captured if the wastewater is treated before being released. If the chemicals are captured, they may be disposed of by other methods such as incineration or in a landfill. Each of the disposal techniques (wastewater, incineration, landfill) has potential adverse environmental impacts that vary according to the characteristics of the actual chemicals involved.

Many formulators already have experience handling FR chemicals and the increase in formulations involving FR chemicals due to the standard will only be a matter of degree. For example, they may have experience formulating FR systems for use in foams, transportation upholstery, carpeting, or the plastics industry. In fact, The Fire Retardant Chemicals Association (FRCA) estimates that 165 to 190 million pounds of FR chemicals are already used in textile applications in the United States; 120 to 130 million pounds of this is on carpets.[4] As noted earlier, CPSC staff estimate that the standard will increase the use of FR chemicals by approximately 25 to 30 million pounds annually. This is less than one-fifth of the amount already used in other textile operations and an even smaller

[3] "Upholstered Furniture Flammability: Preliminary Regulatory Analysis," Charles L. Smith, Directorate for Economic Analysis, U.S. Consumer Product Safety Commission, June 1997.
[4] Letter from Russell C. Kidder (Executive Vice President - FRCA) to CPSC, 15 July 1998.

fraction of the total use of FR chemicals. Therefore, although some formulators, such as those that have primarily served the upholstery fabric producers, may not have experience with the use of FR chemical systems, the overall increase due to the standard is small.

To the extent that the formulation of chemical flame retardant systems has adverse environmental impacts, the standard will not significantly increase the impact. Some formulators may need to gain experience with handling FR chemicals and may incur costs in acquiring this experience and installing any new equipment that may be required to meet federal, state, or local environmental regulations. Moreover, most formulators that would be involved in the formulation of FR systems to meet the CPSC standard probably already use other chemicals that are not entirely benign if released into the environment. Therefore, most formulators probably already have some controls that limit the release of chemicals into the environment.

Fabric Finishers

Fabric finishers take the fabric from the fabric manufacturer and add backcoatings, soil release agents, and other fabric treatments. Most upholstery fabric is already processed in some way by fabric finishers. FR chemicals would likely be added to the fabric at this stage of production, either in a backcoating or in an immersion treatment. Backcoatings are applied to the fabric in liquid form and then the fabric is passed through an oven at a temperature of 130 to 140 degrees centigrade to drive off the moisture. Immersion treatments involve soaking the fabric in a chemical bath during which the FR chemicals coat and are bound to the fibers of the fabric. Some immersion treatments involve baking the fabric to fix or cure the FR chemicals. Then the finished fabric is wound in rolls or bolts for storage and transportation. Although a couple of large fabric manufacturers may have their own finishing operations, most fabric manufacturers send their fabric to independent finishers for processing.

Environmental releases can occur at several points in the finishing operations. For example, chemical byproducts, such as formaldehyde, are produced by some FR-treatment methods. Some chemicals may be released during the drying process in the form of vapors. The equipment used for backcoating will have to be washed out from time to time. This includes the vats, tanks, drums, or barrels in which the backcoating was shipped and the rollers used to apply the backcoating. Chemicals will be in the wastewater. In some cases the chemicals may be settled out or skimmed off and disposed of through incineration, landfill or well injection. However, some of the chemicals may remain in the water as it is discharged.

The chemicals may also be released if they can migrate from the backcoating. Therefore, workers handling the fabric may be exposed to the chemicals when they handle the fabric. Even if bonded in some form, such as in a backcoating or to the fabric fibers, some of the chemicals may remain on the fabric surface. If any of the chemicals were volatilized during the finishing operations, the chemicals may settle on the surface of the fabric and be a source of exposure to workers.

Although some fabric finishers have experience using FR systems (especially some that have experience with protective apparel or transportation fabrics, carpets, or exports to Britain) it is expected that most finishers that work with fabric intended for upholstered furniture do not have experience with FR chemicals. However, a substantial portion of upholstery fabric is already processed

by finishers. The processing involves applying a backcoating (without FR chemicals) in approximately 50 percent of the fabric, applying soil- or water-resistant treatments, or rinsing operations. The standard may increase the amount of wastes generated by these facilities. However, the environmentally safe disposal of these wastes is possible and therefore not likely to have a significant adverse impact on the environment. However, the safe disposal of these wastes may increase the costs to the finishers.

Workers at fabric finishing facilities may be exposed to FR chemicals used at the facility. Given that FR chemicals that are likely to be used to meet the standard are already widely used in other industries (including some textile applications) there are in all likelihood means in existence that can keep worker exposure to relatively safe levels. However, if any particular FR chemical requires special controls or practices to reduce the risk to workers that are not already in use at a facility, there may be a cost to the facility to obtain the necessary equipment or to institute the new practices.

Moreover, fabric finishers already have experience in handling chemicals safely and in meeting various federal, state, and local regulations regarding environmental and worker safety. The standard may increase the number and type of chemicals handled by fabric finishers, but the FR chemicals are not necessarily more toxic than other chemicals handled by fabric finishers. Although there may be some costs involved, fabric finishers should be able to integrate FR chemicals into their operations without causing significant adverse impacts on worker health or the environment.

At the CPSC staff's request, the Hazard Evaluations and Technical Assistance Branch of the National Institute of Occupational Safety and Health (NIOSH) undertook a Health Hazard Evaluation study of some FR chemicals. As part of this study, NIOSH inspected five manufacturing facilities involved in the application of FR chemicals onto fabrics (and one manufacturer that used FR treated fabrics in the manufacture of office furniture). In a letter to Dale Ray, dated 15 February 2001, NIOSH reported that it found the potential for worker exposure to the specific chemicals investigated at these facilities to be low, by either the dermal or the inhalation routes. They noted that workplace controls are already in place to minimize such exposures. NIOSH believes that their findings may be generalized to the fabric finishing industry as a whole. However, they caution that they were not aware of any actual data for worker exposure to FR chemicals in upholstered furniture fabric treatment operations and, therefore, they will be conducting exposure assessment site visits in the near future to document these exposures.

Furniture Manufacturing

Intermediate Handling

After the fabric is finished there may be some handling of the finished fabric before it is shipped to the furniture manufacturer, or other purchaser. For example, the fabric may be shipped back to the fabric manufacturer where it will be inspected to ensure that the fabric meets the specifications. Then the fabric may be stored in a warehouse. While in the warehouse, the fabric may from time to time be unrolled and inspected by potential customers of the fabric manufacturer (e.g., furniture manufacturers and fabric wholesalers). The fabric may be undergo some other processing when it is sold, such as cutting, folding, or winding.

Treating the fabric with FR chemicals is not expected to change the way in which these operations are carried out. Workers who come into direct contact with the fabric could be dermally exposed to the FR chemicals if the chemicals can migrate from the fabric or backcoating. Workers could also be exposed to the chemicals through inhalation if dust impregnated with FR chemicals is generated or if the FR chemicals are volatile. However, CPSC staff do not have cause to conclude that this exposure would result in significant harm to the workers. These exposures are likely to be similar to the exposure of workers in other industries where these same FR chemicals are used, including some textile applications. If concerns do arise in relation to a particular chemical, appropriate controls could be established to minimize the risk. Or, potentially, another chemical or FR treatment could be substituted.

Furniture Manufacturers

FR fabric treatments may have some impact on the furniture manufacturers operations. One method of FR-treatment likely to be used for upholstered furniture is adding FR chemicals to a backcoating. Currently, only about 50 percent of upholstery fabric is backcoated. This percentage is likely to increase if the standard is issued. Furthermore, adding the FR treatment to backcoated fabrics may require that the backcoating be thicker. The FR backcoating may make some manufacturing operations more difficult. For example, equipment used for cutting the fabric may have to be cleaned more often. The fabric may be slightly heavier or stiffer due to the backcoating. Thus there may be some increase in labor, energy, and other resources required for various operations such as stretching, cutting, or sewing the fabric. Potentially, if the operations are significantly more difficult there could be an increase in workplace injuries. However, it is likely that these problems could be reduced by changing the equipment, tools, or procedures used. These changes may result in economic costs to the firms, but they are unlikely to result in a significant adverse impact on the environment.

Changes in manufacturing operations required by other FR treatment options, such as immersion treatments of the fabric with FR chemicals or adding FR barriers to the furniture, are unlikely to cause any significant adverse environmental impact. Changes required by immersion treatments of the fabric, if any, will be minor. The addition of a FR barrier to the fabric will add additional steps to the manufacturing process that will result in increased consumption of energy, labor, and other resources. However, the increased use of these resources will be small, especially compared to the total regional use of these resources and are not likely to result in any significant adverse environmental impact.

During the manufacture of upholstered furniture, workers will have contact with the FR-treated fabrics. Workers may also be exposed to dust from FR-treated fabrics as a result of manufacturing operations, such as cutting or stretching the material, that abrade the fabric surface or backcoating. If the FR chemicals involved are toxic and are bioavailable through the manner in which the worker is exposed to the chemical, the worker could suffer adverse health effects. However, currently, the CPSC staff is not aware of any evidence that the worker exposure to FR chemicals in furniture manufacturing industries will pose a greater risk than that which occurs in other industries using these chemicals.

During manufacturing operations, rag waste (unusable scraps of fabric) are produced. Most rag waste is recycled and sold for other uses, such as for sound insulation in automobiles, as packaging materials, and other similar uses. At some point, however, this rag waste will be disposed and the fate of the FR chemicals used on the fabric in the environment needs to be considered. The possible environmental impacts will depend on the characteristics of the individual chemicals involved. For example, a chemical that has a tendency to bind to soil particles may be unlikely to migrate from a landfill to ground or surface waters and therefore, be unlikely to cause an adverse impact if disposed of in a landfill. On the other hand, some chemicals may not bind to soil particles and could migrate to a body of water where it could have an adverse impact if the chemical is "eco-toxic." Incineration of rag waste containing FR chemicals will release combustion break down products into the atmosphere. The exact chemicals released will depend on the FR chemicals contained in the waste and the conditions in the incinerator. For example, some brominated or chlorinated FR chemicals may release polyhalogenated dioxins and furans. Although incineration at sufficiently high temperatures or a sufficient length of time may minimize the formation of dioxins and furans it will never eliminate their formation.[5]

Although the disposal of rag waste containing FR chemicals could have some adverse environmental impacts, these impacts are unlikely to be significant. These FR chemicals are already widely used and the products they are used in are also eventually disposed. Thus, any adverse environmental impact from the disposal of products containing these FR chemicals is already occurring. The marginal increase in FR chemicals being disposed of in landfills or by incineration as a result of the standard is unlikely to have a significant increased adverse impact on the environment. Moreover, if the Environmental Protection Agency (EPA) or another regulatory agency determined that disposal of rag waste treated with a particular FR chemical could have an adverse impact, it could establish controls or procedures with regards to the disposal of waste treated with that particular chemical to minimize the impact.

Distribution

The standard will have little impact on the distribution of finished upholstered furniture through the distribution network from the manufacturer to the consumer.[6] Any impact would likely derive from the added weight of the flame-retardant chemicals that were incorporated in the fabric. The extra weight may cause a slight increase in the amount of energy required to move the finished furniture from the manufacturer to the ultimate consumer. FR chemicals are expected to increase the weight of upholstered furniture by an average of 1.25 pounds per unit.[7] The increased energy requirements caused by this weight increase is unlikely to have any significant adverse impact on the environment.

Various workers may handle the furniture while it is being moved from the manufacturer to the consumer. These workers may be exposed to any of the flame-retardant chemicals that can be released

[5] All combustion processes will produce dioxins and furans. Their production is not limited to the combustion of FR chemicals.

[6] The distribution network may include various intermediate steps such as shipment to a wholesalers warehouse, to a retail store, and finally to the ultimate consumer.

[7] "Economic Analysis of Regulatory Options Addressing Small Open Flame Ignition of Upholstered Furniture," Charles L. Smith, Directorate for Economic Analysis, U.S. Consumer Product Safety Commission, October 2001.